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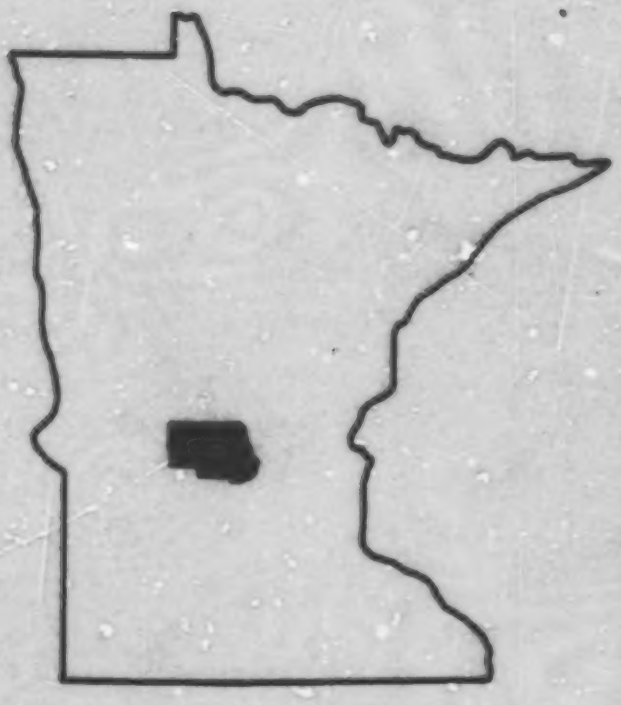
FLOOD INSURANCE STUDY



STEARNS COUNTY, MINNESOTA
UNINCORPORATED AREAS

ORIGINAL

SEPTEMBER 16, 1988

Federal Emergency Management Agency

COMMUNITY NUMBER - 270546

COMPLETED

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NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance study purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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Flood Boundary and Floodway Map		

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY
UNINCORPORATED AREAS OF STEARNS COUNTY, MINNESOTA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the unincorporated areas of Stearns County, Minnesota, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses in this updated study represent a revision of the original analyses prepared by Barr Engineering Co., for the Federal Emergency Management Agency (FEMA), under Contract No. H-3799. The work for the original study was completed in May 1977. The hydrologic and hydraulic analyses in this updated study were prepared by the St. Paul District of the U. S. Army Corps of Engineers (COE), under Inter-Agency Agreement No. EMW-84-E-1506, Project Order No. 1, Amendment No. 14. This work was completed in June 1986.

1.3 Coordination

In March 1984, an initial Consultation and Coordination Officer's (CCO) meeting was held with representatives from FEMA, county officials, the Minnesota Department of Natural Resources (MDNR), and the COE (the study contractor) to determine the streams to be studied by detailed methods. In May 1986, an intermediate CCO meeting was held with county officials to provide the county an opportunity to review flood elevations and flood boundaries and to select a floodway consistent with the county's land use plan.

Data used in this study were coordinated with the COE, the U. S. Geological Survey (USGS), the Soil Conservation Service (SCS), the MDNR, the U. S. Coast and Geodetic Survey (USC&GS), and the Minnesota Department of Transportation.

On June 4, 1987, a final CCO meeting was held with representatives from FEMA, the county, the MDNR, and the study contractor to review the results of the study.

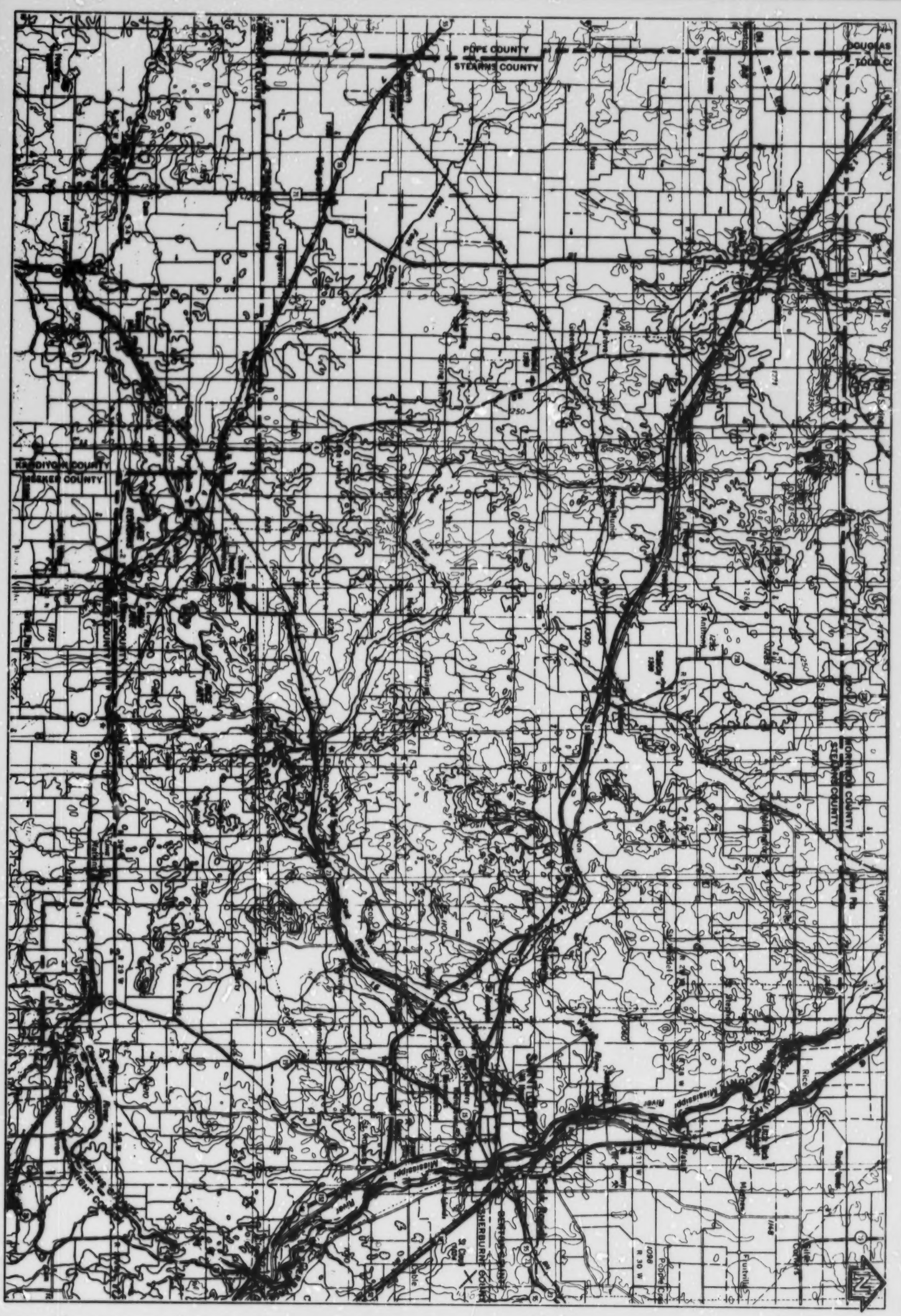
2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of Stearns County, Minnesota. The following communities are located within the unincorporated areas of Stearns County but are not included in this study: the Cities of Avon, St. Anthony, Cold Spring, Freeport, Greenwald, Holdingford, Melrose, New Munich, Paynesville, Richmond, Rockville, Sauk Centre, Sartell, St. Cloud, St. Joseph, St. Stephen, and Waite Park; and the Villages of Albany, Belgrade, Brooten, Eden Valley, Elrosa, Kimball Prairie, Lake Henry, Meire Grove, Peasant Lake, Roscoe, Spring Hill, St. Rosa, and St. Martin. The area of study is shown on the Vicinity Map (Figure 1).

Streams studied by detailed methods are shown in the following tabulation; the portions that were updated or added in this study are specified:

Stream	Limit of Detailed Study
Mississippi River	for its entire length within the community;
Watab River	from the western corporate limits of Sartell to the outlet of Watab Lake;
Sauk River	from its confluence with the Mississippi River near the City of St. Cloud to a point approximately 2 river miles upstream of the City of Rockville corporate limits; the portion from the upstream corporate limits of Cold Spring to the downstream corporate limits of the City of Richmond was added;
Clearwater River	added from its confluence with the Mississippi River to State Route 55;
North Fork Crow River (Mud Lake)	added from the inlet of Lake Koronis to the Soo Line Railroad; and
North Fork Crow River	from the upstream side of State Route 23 to the upstream northern corporate limits of Paynesville (county boundary).



FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

FIGURE 1

3

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Lake Koronis and Rice Lake were also studied by detailed methods for their entire shorelines within the county. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through June 1991.

The following streams were studied by approximate methods: Kolling Creek; the South Two River; the remaining portions of the North Fork Crow River; and Two River, Sauk, Browns, Eden, and Roschien Lakes. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and Stearns County.

2.2 Community Description

Stearns County is located in central Minnesota. It is bordered by the unincorporated areas of Todd and Morrison Counties to the north; the unincorporated areas of Benton and Sherburne Counties to the east; the unincorporated areas of Douglas and Pope Counties to the west; and the unincorporated areas of Kandiyohi, Meeker, and Wright Counties to the south. St. Cloud, the largest city in Stearns County, is located near the confluence of the Sauk and Mississippi Rivers on the eastern county boundary. The county has an area of approximately 1,394 square miles with a population of 108,161 in 1980 (Reference 1).

Agricultural cropland and meadows are the primary vegetal cover in Stearns County. Numerous scattered woodlands are found on farmsteads. Marsh and wetland areas are interspersed throughout the county with their many characteristic wetland vegetation types. The unincorporated areas of the county remain basically undeveloped. Development generally occurs in the form of agricultural structures.

The climate classification of Stearns County is humid continental with seasonal variations in temperature ranging from 9 degrees Fahrenheit (^{o}F) in January to 70^{o}F in July. The mean annual temperature is 43^{o}F. The average annual precipitation is 27 inches, and the average annual snowfall for Stearns County is 42 inches (Reference 2).

The soils in Stearns County vary from lowland river bottom areas to the hilly upland areas. The bottom lands that follow along the Mississippi, Sauk, and North Fork Crow Rivers are characteristically level and undulating, excessively drained soils formed in loamy and sandy outwash materials. The upland areas that cover the remainder of the county are comprised of well-drained rolling and hilly soils formed in sandy loam and loam glacial till.

The topographic relief is quite uniform in Stearns County. The landscape can be characterized as gently rolling plains in the

southeast to hilly terrain in the western portion of the county with elevations varying from 1,000 to 1,350 feet. The Mississippi, Watab, and Sauk Rivers lie in valleys that gradually descend from adjacent land surfaces.

2.3 Principal Flood Problems

The most severe flooding of lakes and rivers in Stearns County occur during spring snowmelt events. Characteristic conditions that have led to flooding in this region are frozen, saturated ground, combined with rapid snowmelt and rain. Restrictive characteristics of certain man-made structures have, during larger floods of record, caused inundation of land areas. On the Mississippi River, the largest floods occurred in 1950, 1952, 1962, 1965, 1966, and 1969. The 1965 flood, the largest flood of record, was comparable to approximately a 100-year frequency flood. The magnitude of the 1969 flood, the most recent flood, varies from approximately a 20-year to 30-year frequency along the Mississippi River in Stearns County.

Flooding could occur along the Mississippi, Watab, and Sauk Rivers because of restrictions formed by floating debris and ice jams. There is insufficient historic information available to predict the location and degree of debris or ice accumulation. With the exception of a rain storm that occurred in the summer of 1983, there is no other existing data on past flooding problems in the Clearwater River basin. Rainfall amounts for the storm of June 21, 1983, averaged 9.19 inches over the watershed. This storm exceeded the 100-year 12-hour storm of 5.1 inches. The following tabulation shows major flooding on the North Fork Crow River at Paynesville at the Paynesville USGS gage in Stearns County (Reference 3):

Date	Peak Discharge (cfs)	Approximate Recurrence Interval (years)
1965	2,781	30
1983	2,300	16
1984	2,300	16
1952	2,242	14
1979	1,640	6
1951	1,481	5
1975	1,320	4
1982	1,170	3
1947	1,089	3
1950	1,008	2

No gaging station data were available for the Clearwater River.

2.4 Flood Protection Measures

There are no permanent, certified structures for flood protection in the unincorporated areas of Stearns County, and no construction is expected in the immediate future.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency and peak elevation-frequency relationships for each flooding source studied in detail affecting the county.

The 100-year flood discharges for the Mississippi River were established by an MDNR Interagency agreement dated January 18, 1974 (Reference 4). This agreement was based on records from three gaging stations: the Mississippi River stations at Royalton, St. Cloud, and the Elk River. The discharges at St. Cloud were obtained from the log-Pearson Type III regional frequency analysis of the Mississippi River from St. Paul to Royalton (Reference 5). The frequency analysis was based on the following: the Mississippi River at Royalton, based on 51 years of record (1924-1974); the Mississippi River at the Elk River, based on 57 years of record (1916-1973); and the Mississippi River at St. Paul, based on 106 years of record (1867-1972). The discharges used in the detailed study areas of the Mississippi River are based on this frequency analysis.

Flood discharges for the Watab River were developed using the frequency curves for the Sauk River near St. Cloud. Discharge-frequency curves were transferred to the Watab River using the 0.7 power of the drainage area ratio. The discharges were verified utilizing SCS Technical Release No. 20 computer program (Reference 6). The computer program uses the physical characteristics of the watershed to predict the flood discharge that

would occur from a rainfall event of a selected frequency. Runoff depth for a given rainfall depth was determined based on soil type, land use, land treatment, and general hydrologic conditions in the watershed. Soil types were determined for the computer program using general soils maps for Stearns County prepared by the SCS (Reference 7). Land use and watershed boundaries were determined from USGS topographic maps at a scale of 1:62,500 with contour intervals of 10 and 20 feet, topographic maps at a scale of 1:24,000 with a contour interval of 10 feet, and by field reconnaissance (References 8 and 9).

The discharge-frequency relationships for the Sauk River from its confluence with the Mississippi River near St. Cloud to Richmond are based on 48 years of record (1902-1912, 1930-1931, 1934-1975) from the USGS Sauk River gage located approximately 5 miles above the confluence with the Mississippi River (Reference 10). Flood discharges were developed at the confluence and upstream to Cold Spring and Richmond by transferring the frequency curve for the Sauk River at the gage using the 0.6 power of the drainage area ratio. The flood discharges for the Sauk River near St. Cloud and at Cold Spring were established on January 18, 1974, and the discharges at Richmond were established on December 27, 1976 (References 4 and 11).

Discharge-frequency relationships for the Clearwater River were determined by applying the COE HEC-1 rainfall-runoff model (Reference 12). The entire watershed above the confluence with the Mississippi River was modeled. Thirteen subbasins, nine reservoir routings, and 11 combining units were used. Snyder's unit hydrograph parameters Cp, a coefficient accounting for flood wave and storage conditions, and Ct, a coefficient representing variations of watershed slopes and storage, were transferred to the Clearwater basin from a study performed on the North Fork Crow River, near Regal, that is hydrologically similar (Reference 13). The parameters were determined using HEC-1 optimization capability for two selected historic events that occurred at that site (Reference 12). A 10-day storm duration was selected to insure that the most critical duration of storm was modeled for the lakes. The 10-, 50-, 100-, and 500-year, 10-day precipitation values were obtained from HYDRO-35, Technical Paper 40, and Technical Paper 49 (References 14, 15, and 16). SCS curve numbers were used to determine rainfall excess. These curve numbers were estimated from information obtained from the Minnesota Land Management Information Center. The HEC-1 model was calibrated to a USGS peak discharge estimate based on a discharge measurement made on the Clearwater River upstream of the State Route 75 bridge following the June 21, 1983 storm. A discharge of 2,150 cubic feet per second (cfs) was recorded on June 23, 1983, and is believed to be within 0.2 foot of the peak stage with an estimated peak discharge of 2,610 cfs. This storm produced an average rainfall over the watershed of 9.19 inches (Reference 17). Three methods were used to validate the peak flow

values obtained from the HEC-1 model. The first method used a COE Open-File report for the City of Clearwater, in which a USGS regression analysis was performed (References 18 and 19). The equations used accounted for basin area, slope, and storage. The second method utilized another USGS study of the June 21, 1983 storm that used updated regression equations that took into account basin area, storage, mean annual runoff, and forest cover (Reference 17). The third method was the generalized SCS Technical Release No. 20 model used in the final analysis of the Clearwater report (Reference 6). Based on these comparisons, the HEC-1 values were adopted.

For the North Fork Crow River (Mud Lake), Lake Koronis and Rice Lake, HEC-1 was used to model the watershed (Reference 12). Eight subbasins, four reservoir routings, and eight combining units were used. The HEC-1 model was calibrated to the discharge-frequency curve developed for the North Fork Crow River near Paynesville. The SCS curve numbers were used to determine loss rates for each recurrence interval. Snyder's unit hydrographs were used to transform rainfall to runoff from the subbasins. Snyder's regional coefficient and standard lag were determined using HEC-1 optimization capabilities on two selected historic events on the North Fork Crow River near Regal (Reference 12). Stream flow routing was done using Muskingum routing. The 10-, 50-, 100-, and 500-year, 10-day hypothetical precipitation values were obtained from Technical Paper 40 and Technical Paper 49 (Reference 15 and 16). The lakes that were considered to be a large percentage of their contributing drainage areas were modeled with a single-ordinate unit hydrograph to return 100 percent of the precipitation that falls within each time step. A 10-day duration storm was selected to insure that the most critical duration was modeled. The basin simulation was made with a 90-minute computation interval. Due to effects from Lake Koronis on the rating curve for the outlet of Mud Lake and the effect of Mud Lake levels on the rating curve for the outlet of Rice Lake, an interactive process between the HEC-2 model and the HEC-1 model was made to determine the rating curves for the outlets of Mud and Rice Lakes (References 20 and 12). This was done by assuming a rating curve at each outlet and then simulating the system with modified Puls routing through the lakes. Using the resulting Lake Koronis peak elevation as a starting HEC-2 water-surface elevation, backwater computations were performed from Lake Koronis to the outlet of Rice Lake with HEC-1 outflows from Mud Lake and Rice Lake. Adjustments were made in the storage-elevation relationship for Mud Lake as determined from HEC-2 and the rating curves until there was agreement between the HEC-1 and HEC-2 model runs thus reflecting equilibrium conditions for the system. The starting water-surface elevation for Lake Koronis used in the HEC-1 model was 1,122.6 feet or 0.6 foot above the crest of the outflow dam.

Flow frequencies for the North Fork Crow River near Paynesville were based on a statistical analysis of USGS gage data (Reference 3). These data were analyzed in accordance with criteria outlined in Bulletin 17B and the COE Flood Flow Frequency Analysis (Reference 21 and 22). A discontinued continuous USGS gage on the North Fork Crow River at Regal (No. 05276000) and a crest stage USGS gage at Paynesville (No. 05276200) were selected for the analysis. The Regal gage has 12 years of record (1944-1954, and 1965). Instantaneous peak flows at this station were adjusted to the station at Paynesville by drainage area ratio to the 0.6 power. The gage at Paynesville has 12 years of record (1973-1984) for a total of 24 years of systematic record when combined with Regal's record. According to USGS Water Supply Paper 1850-A, the maximum previously known discharges at the Regal station for the period 1944-1965 occurred in 1951 and 1952 (Reference 23); therefore, the 1965 event is estimated to be the largest event in the period 1943 to 1984. The station skew was weighted with a regional skew of -0.18 (mean square error of 0.125) as determined from the St. Paul District skew map. The discharges at the gage site were transferred upstream to section line 17/18 and downstream to section line 14/15 with measured drainage areas of 241 and 255 square miles, respectively. The transfer was made using a drainage area ratio to the 0.60 power.

A summary of the drainage area-peak discharge relationships for the flooding sources studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
MISSISSIPPI RIVER					
At Station 0.44[1]	13,616	35,460	52,000	59,570	77,100
At Station 8.02[1]	13,437	34,270	49,340	57,900	78,120
At Station 16.03[1]	13,313	33,970	48,955	57,450	*
At Station 20.88[1]	12,265	29,410	42,430	49,335	66,495
At Station 30.78[1]	12,098	28,560	41,060	47,840	64,480
At Station 32.49[1]	12,063	26,930	38,660	44,965	60,605
WATAB RIVER					
At Station 0.48[2]	67.5	770	1,490	1,880	3,160
At Station 2.63[2]	57.9	710	1,370	1,730	2,910
At Station 5.13[2]	53.7	680	1,310	1,650	2,780
At Station 5.46[2]	36.0	500	970	1,220	2,050

[1]Miles above centerline of State Route 24
[2]Miles above confluence with Mississippi River
*Information not available

TABLE 1 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
SAUK RIVER					
At Station 0.00[1]	970	4,350	8,230	10,300	16,450
At Station 4.80[1]	925	4,230	8,000	10,000	16,000
At Station 15.68[1]	895	4,150	7,850	9,800	15,675
At Station 15.82[1]	846	4,010	7,585	9,475	15,150
At Station 19.83[1]	832	3,970	7,510	9,380	15,000
At Station 0.26[2]	728	3,660	6,930	8,660	13,845
CLEARWATER RIVER					
At confluence with Mississippi River	171.4	740	1,310	1,560	2,340
At bridge below Weigand Lake	160.2	730	1,280	1,530	2,290
At Lake Caroline outlet	94.0	670	1,110	1,320	2,020
At Fairhaven Dam	91.2	640	1,070	1,280	1,940
At State Route 55, Lake Louise inlet	81.5	610	1,010	1,190	1,790
NORTH FORK CROW RIVER (MUD LAKE)					
At Lake Koronis outlet highway bridge	308	840	1,450	1,680	3,100
At Mud Lake outlet State Route 55 bridge	277	1,080	1,920	2,230	3,510
At Rice Lake outlet railroad bridge	271	1,060	1,900	2,210	3,450
NORTH FORK CROW RIVER					
At section line 14/15	255	1,949	3,095	3,647	5,044
At Paynesville gage No. 05276200	253	1,940	3,080	3,630	5,020
At section line 17/18	241	1,884	2,991	3,526	4,876

[1]Miles above confluence with Mississippi River
[2]Miles above centerline of State Route 23

The stillwater elevations for the 10-, 50-, 100-, and 500-year floods have been determined for Koronis and Rice Lakes and are summarized in Table 2, "Summary of Stillwater Elevations."

TABLE 2 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
LAKE KORONIS for its entire shoreline within community	1,125.71	1,127.16	1,127.66	1,128.75
RICE LAKE for its entire shoreline within community	1,126.67	1,127.86	1,128.43	1,129.81

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the Mississippi, Watab, and Sauk Rivers were obtained from aerial photographs at a scale of 1:12,000 and field surveys (Reference 24). Cross sections for the Clearwater River, North Fork Crow River (Mud Lake), and the North Fork Crow River were obtained from field surveys. Cross sections for the analysis were located at close intervals upstream and downstream of bridges, culverts, and other structures in order to compute significant backwater effects of these structures. Other cross sections for the Mississippi River were located along the watercourse in a manner that would provide a typical representation of the stream valley topography.

Effective flow areas of the floodplain cross sections, loss coefficients for bridges and other channel obstructions, and channel and overbank roughness coefficients were initially assigned to eah cross section based on field inspection. Adjustments were made to coefficients until the computed high-water profiles using HEC-2 step-backwater program matched the historic high-water profiles of the April 1965 flood on the Mississippi River (Reference 20). The coefficients obtained by matching the historic high-water profiles were then used to determine the 10-, 50-, 100-, and 500-year frequency flood profiles.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals for the Mississippi River from the upstream corporate limits of Clearwater to the downstream corporate limits of St. Cloud and from the upstream corporate limits of Sartell to the Stearns and Morrison County boundaries were computed using the COE HEC-2 step-backwater computer program (Reference 20). For the Mississippi River from the upstream St. Cloud corporate limits to the downstream corporate limits of Sartell were obtained from the Flood Insurance Study for the City of Sauk Rapids (Reference 25). Water-surface elevations for the remaining streams studied by detailed methods were also computed using the COE HEC-2 step-backwater computer program (Reference 20). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Starting water-surface elevations for the Mississippi River from the upstream corporate limits of Clearwater to the downstream corporate limits of St. Cloud were calculated using the slope/area method. Starting water-surface elevations for the remaining portions of the Mississippi River studied by detailed methods were determined from discharge curves for the St. Regis Dam taken from the St. Cloud Flood Plain Information study (Reference 26).

Starting water-surface elevations for the Watab River and the Sauk River at the confluence with the Mississippi River were determined from data produced for the Mississippi River in this study. Starting water-surface elevations for the remaining portions of the Sauk River studied by detailed methods were determined using water-surface elevations obtained from the Flood Insurance Study for the City of Cold Spring and by using the HEC-2 computer program (References 27 and 20).

Starting water-surface elevations for the Clearwater River were taken from the Flood Insurance Study for the City of Clearwater (Reference 28).

Starting water-surface elevations for North Fork Crow River (Mud Lake) were determined from storage routings for Lake Koronis. Starting water-surface elevations for the North Fork Crow River near Paynesville were determined using the slope/area method.

Channel and overbank roughness factors for the streams studied by detailed methods were determined based on field inspection and are summarized in the following tabulation. Adjustments were made to the North Fork Crow River coefficients until the computer profile, using the HEC-2 computer program, matched the historic data at the USGS gage located at the downstream side of the township road bridge in Paynesville (Reference 20).

Stream	Channel "n"	Overbank "n"
Mississippi River	0.025 - 0.035	0.060 - 0.090
Watab River	0.030 - 0.045	0.030 - 0.100
Sauk River	0.030 - 0.040	0.040 - 0.090
Clearwater River	0.036 - 0.044	0.072 - 0.088
North Fork Crow River (Mud Lake)	0.040	0.100
North Fork Crow River	0.035 - 0.045	0.078 - 0.100

The 100-year flood elevations for the portions of the North Fork Crow River studied by approximate methods were based on existing North Fork Crow River historic water-surface profiles published by the COE and a field inspection of the study area (Reference 29). Flood elevations for the approximate study of the Sauk River were based on existing Sauk River profiles published by the COE, a review of Flood-Prone Area Maps produced by the USGS, and a field inspection of the study area (References 30, 31, and 32).

Two River Lake, also studied by approximate methods, was based on Minnesota Department of Transportation design discharge curves and culvert nomographs and a field inspection of the study area (Reference 33).

For Brown and Eden Lakes studied by approximate methods, the data presented were based on SCS soils maps and historic high-water marks recorded by the MDNR.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing floodplain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional

areas of flood risk in the community. For the flooding sources studied in detail, the 100- and 500-year floodplain boundaries have been delineated using aerial photographs and topographic maps (References 24 and 9).

For the flooding sources studied by approximate methods, the 100-year flood boundaries were delineated using topographic maps (References 8 and 9).

The 100- and 500-year floodplain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. However, the State of Minnesota has established criteria limiting the increase in flood heights to 0.5 foot. Thus, a floodway having no more than a 0.5-foot surcharge has been delineated for this study. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

After consultation with representatives of the Minnesota Department of Natural Resources, responsible community officials have designated floodways for the streams studied by detailed methods. The floodways selected are based on existing legal, economic, political, and hydraulic factors.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the floodplain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 3). Portions of the floodway widths for the Mississippi, Watab, Sauk, Clearwater, and North Fork Crow Rivers extend beyond the corporate limits.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Mississippi River								
A	1.03	450	3,875	6.7	949.2	949.2	949.5	0.3
B	1.48	400	3,000	5.3	950.4	950.4	950.8	0.4
C	1.93	280	4,850	6.1	950.6	950.6	951.0	0.4
D	2.39	1,950	23,800	2.1	951.2	951.2	951.6	0.4
E	3.02	200	4,850	6.1	951.5	951.5	951.9	0.4
F	3.50	3,250	21,600	2.3	952.4	952.4	952.7	0.3
G	4.05	2,450[3]	8,900	4.5	952.4	952.4	952.7	0.3
H	4.61	520	7,250	4.0	953.5	953.5	953.9	0.4
I	5.13	640	9,000	3.3	954.0	954.0	954.4	0.4
J	5.55	260[3]	3,890	7.3	954.0	954.0	954.4	0.4
K	6.04	250	4,300	6.8	955.3	955.3	955.7	0.4
L	6.37	330	4,350	6.7	956.1	956.1	956.4	0.3
M	6.91	570	4,750	6.2	957.8	957.8	958.1	0.3
N	7.42	270	4,100	7.1	959.1	959.1	959.4	0.3
O	8.02	300	3,550	8.2	960.7	960.7	961.1	0.4
P	8.53	310	5,300	2.2	963.0	963.0	963.3	0.3
Q	8.99	560	4,100	6.8	963.6	963.6	963.9	0.3
R	9.45	730[3]	7,200	2.6	964.0	964.0	964.3	0.3
S	9.81	1,920[3]	7,200	4.0	964.5	964.5	964.8	0.3
T	10.32	780	5,000	7.8	966.6	966.6	967.1	0.5
U	10.66	770	6,500	3.9	968.2	968.2	968.7	0.5
V	11.23	780	11,284	2.6	969.4	969.4	969.9	0.5
W	11.77	1,020[3]	31,510	1.0	969.7	969.7	970.2	0.5

[1]Miles above State Route 24
[2]This width extends beyond county boundary
[3]Width does not include islands in floodway

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS CO., MN
(UNINCORPORATED AREAS)

FLOODWAY DATA

MISSISSIPPI RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Mississippi River (continued)								
X	15.46	705	8,230	6.8	992.6	992.6	992.9	0.3
Y	15.96	620	7,800	7.3	996.8	996.8	997.1	0.3
Z	16.61	850	11,780	4.2	998.9	998.9	999.2	0.3
AA	20.04	360	9,400	2.6	1,020.1	1,020.1	1,020.4	0.3
AB	20.53	600	10,700	2.3	1,020.2	1,020.2	1,020.5	0.3
AC	20.88	160	3,050	4.9	1,020.2	1,020.2	1,020.5	0.3
AD	21.02	470	10,000	2.5	1,020.5	1,020.5	1,020.8	0.3
AE	21.52	370	7,350	2.3	1,020.7	1,020.7	1,021.0	0.3
AF	22.03	430	9,300	2.4	1,020.8	1,020.8	1,021.1	0.3
AG	22.54	450	7,450	4.0	1,021.2	1,021.2	1,021.5	0.3
AH	23.10	810	11,150	3.1	1,021.7	1,021.7	1,022.0	0.3
AI	23.57	460	6,800	3.1	1,021.9	1,021.9	1,022.2	0.3
AJ	24.04	410	7,800	3.4	1,022.2	1,022.2	1,022.5	0.3
AK	24.54	560	8,800	3.2	1,022.4	1,022.4	1,022.7	0.3
AL	25.02	390	10,700	2.8	1,022.8	1,022.8	1,023.1	0.3
AM	25.39	510	4,200	5.8	1,023.0	1,023.0	1,023.3	0.3
AN	25.93	420	5,200	4.6	1,024.2	1,024.2	1,024.5	0.3
AO	26.43	360	4,800	5.0	1,024.7	1,024.7	1,025.0	0.3
AP	27.11	520	5,700	5.3	1,025.6	1,025.6	1,025.9	0.3
AQ	27.66	1,230	15,500	1.5	1,026.4	1,026.4	1,026.7	0.3
AR	28.35	930	11,050	2.4	1,026.5	1,026.5	1,026.9	0.4

[1]Miles above State Route 24
[2]This width extends beyond county boundary

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS CO., MN

(UNINCORPORATED AREAS)

FLOODWAY DATA

MISSISSIPPI RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Mississippi River (continued)								
AS	28.94[1]	320[3]	12,400	1.9	1,026.7	1,026.7	1,027.0	0.3
AT	29.36[1]	650[3]	11,600	2.0	1,026.9	1,026.9	1,027.2	0.3
AU	29.77[1]	370[3]	14,300	1.8	1,027.0	1,027.0	1,027.4	0.4
AV	30.25[1]	320[3]	12,700	1.8	1,027.3	1,027.3	1,027.7	0.4
AW	30.69[1]	330[3]	13,900	1.7	1,027.5	1,027.5	1,027.9	0.4
AX	30.96[1]	350[3]	5,150	4.2	1,027.8	1,027.8	1,028.2	0.4
AY	31.45[1]	340[3]	4,900	5.3	1,028.6	1,028.6	1,028.9	0.3
AZ	31.90[1]	280[3]	5,050	4.3	1,028.9	1,028.9	1,029.1	0.2
BA	32.49[1]	330[3]	5,300	4.1	1,029.6	1,029.6	1,029.9	0.3
BB	32.96[1]	1,460[3]	7,300	2.3	1,030.2	1,030.2	1,030.5	0.3
Watab River								
A	0.50[2]	40[3]	310	6.0	1,018.5	1,018.5	1,018.5	0.0
B	0.77[2]	90	470	4.0	1,024.2	1,024.2	1,024.2	0.0
C	1.01[2]	70	270	7.0	1,029.1	1,029.1	1,029.1	0.0
D	1.34[2]	320	1,040	1.8	1,032.1	1,032.1	1,032.1	0.0
E	1.96[2]	840	1,740	1.1	1,034.5	1,034.5	1,034.5	0.0
F	2.63[2]	1,640	2,500	0.7	1,035.1	1,035.1	1,035.1	0.0
G	3.39[2]	830	2,830	0.6	1,039.5	1,039.5	1,039.5	0.0
H	3.75[2]	350	1,190	1.5	1,040.0	1,040.0	1,040.0	0.0
I	4.07[2]	260	680	2.5	1,040.5	1,040.5	1,040.5	0.0
J	4.45[2]	610	840	2.1	1,042.2	1,042.2	1,042.2	0.0

[1]Miles above State Route 24
[2]Miles above confluence with Mississippi River
[3]This width extends beyond county boundary

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS CO., MN
(UNINCORPORATED AREAS)

FLOODWAY DATA

MISSISSIPPI RIVER - WATAB RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Watab River (continued)								
K	4.77	570	1,410	1.2	1,044.2	1,044.2	1,044.2	0.0
L	5.13	550	1,470	1.1	1,045.3	1,045.3	1,045.3	0.0
M	5.70	470	2,080	0.6	1,046.9	1,046.9	1,046.9	0.0
N	6.08	190	320	3.9	1,046.9	1,046.9	1,046.9	0.0
O	6.61	720	1,360	0.9	1,047.8	1,047.8	1,047.8	0.0
P	6.73	310	630	1.9	1,047.8	1,047.8	1,047.8	0.0
Q	7.01	250	810	1.5	1,048.2	1,048.2	1,048.2	0.0
Sauk River								
A	0.58	200	1,370	7.5	1,004.3	1,004.3	1,004.3	0.0
B	0.71	250	1,680	6.1	1,006.1	1,006.1	1,006.1	0.0
C	1.11	970[2]	2,830	3.7	1,010.2	1,010.2	1,010.2	0.0
D	1.65	1,270[2]	1,970	5.2	1,015.5	1,015.5	1,015.5	0.0
E	1.98	200[2]	920	11.1	1,018.5	1,018.5	1,018.5	0.0
F	2.48	290[2]	1,690	6.1	1,028.1	1,028.1	1,028.1	0.0
G	3.09	680[2]	2,230	4.6	1,034.3	1,034.3	1,034.3	0.0
H	3.81	1,370[2]	3,510	2.9	1,038.9	1,038.9	1,038.9	0.0
I	4.17	180[2]	1,580	6.5	1,040.6	1,040.6	1,040.6	0.0
J	4.23	1,080[2]	3,750	2.8	1,041.6	1,041.6	1,041.6	0.0
K	4.76	240[2]	2,020	5.1	1,042.9	1,042.9	1,042.9	0.0
L	4.91	120[2]	1,260	8.2	1,043.9	1,043.9	1,043.9	0.0
M	5.35	1,320[2]	5,410	1.8	1,045.9	1,045.9	1,046.4	0.5

[1]Miles above confluence with Mississippi River

[2]This width extends beyond county boundary

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS CO., MN

(UNINCORPORATED AREAS)

FLOODWAY DATA

WATAB RIVER - SAUK RIVER

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Sauk River (continued)								
N	5.83	1,500	7,490	1.3	1,046.2	1,046.2	1,046.6	0.4
O	6.28	720	3,520	2.8	1,049.1	1,049.1	1,049.2	0.1
P	6.60	480	5,200	1.9	1,050.3	1,050.3	1,050.4	0.1
Q	7.41	1,030	5,230	1.9	1,052.6	1,052.6	1,052.8	0.2
R	7.67	2,060	4,350	2.3	1,053.2	1,053.2	1,053.4	0.2
S	7.97	1,210	7,960	1.3	1,053.7	1,053.7	1,053.9	0.2
T	8.39	950	3,300	3.0	1,054.1	1,054.1	1,054.6	0.5
U	8.90	1,030	1,040	9.6	1,055.6	1,055.6	1,056.0	0.4
V	9.15	1,200	3,430	2.9	1,056.0	1,056.0	1,056.5	0.5
W	9.45	1,100	3,900	2.6	1,057.2	1,057.2	1,057.4	0.2
X	9.66	1,060[2]	3,480	2.9	1,057.8	1,057.8	1,057.9	0.1
Y	9.90	650	1,370	7.3	1,058.6	1,058.6	1,058.6	0.0
Z	10.24	1,380	6,410	1.6	1,060.1	1,060.1	1,060.1	0.0
AA	10.65	1,300	4,210	2.4	1,060.4	1,060.4	1,060.5	0.1
AB	10.89	860	2,560	3.9	1,060.9	1,060.9	1,060.9	0.0
AC	11.20	350	2,520	4.0	1,062.4	1,062.4	1,062.4	0.0
AD	11.52	1,110	4,410	2.3	1,063.3	1,063.3	1,063.3	0.0
AE	11.84	640	2,830	3.5	1,063.9	1,063.9	1,063.9	0.0
AF	12.11	580	3,510	2.8	1,064.6	1,064.6	1,046.9	0.3
AG	12.46	1,050	6,150	1.6	1,065.1	1,065.1	1,065.4	0.3
AH	12.69	1,530	10,500	1.0	1,065.3	1,065.3	1,065.5	0.2
AI	12.98	1,340	4,790	2.1	1,065.3	1,065.3	1,065.5	0.2

[1]Miles above confluence with Mississippi River
[2]Width does not include islands in floodway

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS CO., MN
(UNINCORPORATED AREAS)

FLOODWAY DATA

SAUK RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Sauk River (continued)								
AJ	13.27	1,350	5,410	1.8	1,065.8	1,065.8	1,066.0	0.2
AK	13.53	1,480	4,900	2.0	1,066.2	1,066.2	1,066.4	0.2
AL	13.80	1,410	6,010	1.7	1,066.8	1,066.8	1,066.9	0.1
AM	14.06	1,330	4,080	2.5	1,067.1	1,067.1	1,067.2	0.1
AN	14.28	950	6,650	1.5	1,067.5	1,067.5	1,067.6	0.1
AO	14.54	1,270	5,280	1.9	1,067.7	1,067.7	1,067.7	0.0
AP	14.86	620	2,940	3.4	1,068.2	1,068.2	1,068.2	0.0
AQ	15.17	1,160	5,790	1.7	1,069.1	1,069.1	1,069.1	0.0
AR	15,50	260[2]	3,710	2.7	1,069.7	1,069.7	1,069.8	0.1
AS	15.79	1,000[2]	3,310	3.0	1,070.6	1,070.6	1,070.6	0.0
AT	16.23	120[2]	2,900	3.3	1,072.3	1,072.3	1,072.3	0.0
AU	16.62	1,230	6,468	1.5	1,073.2	1,073.2	1,073.5	0.3
AV	16.86	700	4,120	2.3	1,073.5	1,073.5	1,073.8	0.3
AW	17.14	870	4,990	1.9	1,074.1	1,074.1	1,074.2	0.1
AX	17.40	850	3.360	2.8	1,074.5	1,074.5	1,074.7	0.2
AY	17.59	1,210	6,670	1.4	1,075.1	1,075.1	1,075.2	0.1
AZ	17.92	370	2,180	4.3	1,075.6	1,075.6	1,075.7	0.1
BA	18.17	620	3,000	3.2	1,076.7	1,076.7	1,076.7	0.0
BB	18.49	1,230	5,770	1.6	1,077.5	1,077.5	1,077.5	0.0
BC	18.76	1,040	6,610	1.4	1,077.8	1,077.8	1,077.9	0.1
BD	19.11	880	3,640	2.6	1,078.2	1,078.2	1,078.2	0.0
BE	19.30	1,530	6,090	1.6	1,078.8	1,078.8	1,078.8	0.0

[1]Miles above confluence with Mississippi River
[2]This width extends beyond county boundary

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

FLOODWAY DATA

SAUK RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Sauk River (continued)								
BF	19.60[1]	830[4]	4,230	2.2	1,079.2	1,079.2	1,079.3	0.1
BG	19.94[1]	520[4]	2,190	4.3	1,080.1	1,080.1	1,080.1	0.0
BH	20.22[1]	490[4]	2,790	3.4	1,081.2	1,081.2	1,081.2	0.0
BI	20.41[1]	1,160	6,020	1.6	1,081.8	1,081.8	1,081.8	0.0
BJ	20.77[1]	900	4,260	2.2	1,082.1	1,082.1	1,082.1	0.0
BK	21.04[1]	440	2,410	3.9	1,082.5	1,082.5	1,082.5	0.0
BL	21.25[1]	270[5]	2,110	4.4	1,083.1	1,083.1	1,083.1	0.0
BM	0[2]	580[5]	6,270	1.5	1,092.3	1,092.3	1,092.8	0.5
BN	520[2]	630[5]	6,130	1.5	1,092.3	1,092.3	1,092.8	0.5
BO	2,490[2]	230	3,620	2.6	1,092.5	1,092.5	1,093.0	0.5
BP	3,200[2]	470	6,060	1.5	1,092.7	1,092.7	1,093.2	0.5
BQ	5,340[2]	310	3,940	2.4	1,092.8	1,092.8	1,093.3	0.5
BR	5,860[2]	270	4,090	2.3	1,092.9	1,092.9	1,093.4	0.5
BS	6,390[2]	760	9,970	0.9	1,093.0	1,093.0	1,093.4	0.4
BT	22,390[2]	360	5,110	1.8	1,093.5	1,093.5	1,093.9	0.4
BU	22,880[3]	280	3,790	2.4	1,093.5	1,093.5	1,093.9	0.4
BV	0.39[3]	450	3,190	2.7	1,094.4	1,094.4	1,094.9	0.5
BW	0.58[3]	420	2,240	3.9	1,094.6	1,094.6	1,095.0	0.4
BX	0.78[3]	360	3,070	2.8	1,095.6	1,095.6	1,095.9	0.3
BY	0.94[3]	280	2,970	2.9	1,095.7	1,095.7	1,096.0	0.3
BZ	1.26[3]	400	3,604	2.4	1,096.0	1,096.0	1,096.3	0.3
CA	1.72[3]	580	6,054	1.4	1,096.3	1,096.3	1,096.6	0.3

[1]Miles above confluence with Mississippi River
[2]Feet from county boundary
[3]Miles above State Route 23
[4]Width does not include islands in floodway
[5]This width extends beyond county boundary

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS COUNTY, MN

(UNINCORPORATED AREAS)

FLOODWAY DATA

SAUK RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY	INCREASE
Clearwater River								
A	925	150[2]	403	3.9	948.4	939.2[5]	939.6	0.4
B	1,315	220/70[3]	2,259	0.7	954.8	954.8	955.3	C.5
C	1,785	314/170[3]	2,435	0.6	954.8	954.8	955.3	0.5
D	2,625	324/60[3]	1,431	1.1	954.8	954.8	955.3	0.5
E	3,830	330/120[3]	1,681	0.9	955.3	955.3	955.8	0.5
F	4,855	142/50[3]	819	1.9	955.7	955.7	956.2	0.5
G	5,900	118/60[3]	538	2.9	956.6	956.6	957.1	0.5
H	6,800	220/100[3]	770	2.0	958.6	958.6	959.1	0.5
I	7,410	20/10[3]	180	8.5	960.3	960.3	960.5	0.2
J	8,690	103[4]	*	1.8	962.6	962.6	962.7	0.1
K	11,480	90[4]	*	6.4	964.9	964.9	964.9	0.0
L	12,960	264[4]	*	3.2	967.7	967.7	968.2	0.5
M	14,170	60/30[3]	360	4.3	969.2	969.2	969.6	0.4
N	16,570	282[4]	*	2.2	972.3	972.3	972.3	0.0
O	18,830	88[4]	*	0.8	973.3	973.3	973.3	0.0
P	20,890	220/30[3]	590	2.7	974.1	974.1	974.1	0.0
Q	22,300	125[4]	*	1.4	975.1	975.1	975.5	0.4
R	24,760	420/370[3]	1,270	1.2	976.1	976.1	976.5	0.4
S	26,610	570/430[3]	1,150	1.4	977.1	977.1	977.3	0.2
T	28,005	570/530[3]	1,420	1.1	978.4	978.4	978.6	0.2
U	31,075	110/40[3]	400	3.9	980.8	980.8	980.9	0.1
V	32,995	420/370[3]	1,470	1.1	982.1	982.1	982.5	0.4
W	34,875	555/120[3]	1,110	1.4	983.0	983.0	983.4	0.4

[1]Feet above confluence with Mississippi River
[2]Floodway set at shoreline
[3]Width/width within county boundary
[4]Administrative Floodway
[5]Elevation computed without consideration of backwater effects from Mississippi River
*Data not computed

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS CO., MN
(UNINCORPORATED AREAS)

FLOODWAY DATA

CLEARWATER RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Clearwater River (continued)								
X	36,925	500/310[2]	1,250	1.3	984.8	984.8	984.9	0.1
Y	38,675	560/450[2]	1,200	1.3	985.9	985.9	985.9	0.0
Z	39,965	640/210[2]	1,170	1.3	986.8	986.8	986.8	0.0
AA	42,345	250/180[2]	700	2.2	988.4	988.4	988.4	0.0
AB	43,705	230/70[2]	760	2.0	989.4	989.4	989.5	0.1
AC	44,975	155[3]	*	3.1	990.5	990.5	990.9	0.4
AD	45,545	120/100[2]	420	3.7	991.8	991.8	992.2	0.4
AE	47,545	390/200[2]	1,570	1.0	993.3	993.3	993.5	0.2
AF	48,525	90/40[2]	450	3.4	993.5	993.5	993.7	0.2
AG	49,485	180/90[2]	980	1.6	994.2	994.2	994.5	0.3
AH	50,375	190/90[2]	1,040	1.5	994.4	994.4	994.8	0.4
AI	53,005	820/760[2]	4,490	0.3	994.6	994.6	995.0	0.4
AJ	55,665	720/680[2]	3,540	0.4	994.7	994.7	995.1	0.4
AK	56,605	720/600[2]	3,860	0.4	994.7	994.7	995.1	0.4
AL	57,765	490/410[2]	2,660	0.6	994.8	994.8	995.2	0.4
AM	59,975	100/50[2]	570	2.7	995.0	995.0	995.3	0.3
AN	62,565	280/70[2]	870	1.8	995.5	995.5	995.8	0.3
AO	76,505	460/400[2]	2,070	0.6	996.2	996.2	996.7	0.5
AP	77,875	430/180[2]	2,390	0.6	996.4	996.4	996.9	0.5
AQ	80,735	1280/790[2]	14,580	0.1	996.4	996.4	996.9	0.5
AR	82,605	320/190[2]	1,890	0.7	996.4	996.4	996.9	0.5
AS	85,285	340/120[2]	1,970	0.7	996.5	996.5	996.9	0.4

[1] Feet above confluence with Mississippi River
[2] Width/width within county boundary
[3] Administrative Floodway

* Data not computed

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

FLOODWAY DATA

CLEARWATER RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Clearwater River (continued)								
AT	87,945[1]	150/70[3]	1,450	0.9	996.6	996.6	997.0	0.4
AU	89,715[1]	120/30[3]	1,340	1.0	996.6	996.6	997.0	0.4
AV	91,965[1]	340/150[3]	3,640	0.4	996.7	996.7	997.1	0.4
AW	96,365[1]	810[4]	*	0.2	996.7	996.7	997.1	0.4
AX	97,435[1]	220/120[3]	620	2.1	996.7	996.7	997.1	0.4
AY	98,285[1]	70/40[3]	370	3.6	997.9	997.9	998.0	0.1
AZ	98,750[1]	130/20[3]	380	3.4	999.5	999.5	999.5	0.0
BA	99,485[1]	210/190[3]	910	1.5	1,001.1	1,001.1	1,001.1	0.0
BB	100,185[1]	190/90[3]	1,580	0.8	1,008.8	1,008.8	1,008.8	0.0
BC	102,865[1]	370/190[3]	2,960	0.4	1,008.9	1,008.9	1,008.9	0.0
BD	106,215[1]	390/260[3]	2,940	0.4	1,008.9	1,008.9	1,008.9	0.0
BE	106,975[1]	300/200[3]	1,830	0.7	1,008.9	1,008.9	1,008.9	0.0
BF	110,225[1]	560/270[3]	9,880	0.1	1,008.9	1,008.9	1,008.9	0.0
BG	112,665[1]	860/400[3]	5,740	0.2	1,008.9	1,008.9	1,008.9	0.0
BH	115,915[1]	360/320[3]	1,330	1.0	1,008.9	1,008.9	1,008.9	0.0
North Fork Crow River (Mud Lake)								
A	1,775[2]	2,050	10,170	0.1	1,127.9	1,127.9	1,127.9	0.0
B	5,500[2]	1,090	7,514	0.1	1,127.9	1,127.9	1,127.9	0.0
C	11,950[2]	1,400	7,010	0.1	1,127.9	1,127.9	1,127.9	0.0
D	14,040[2]	100	650	3.4	1,128.1	1,128.1	1,128.1	0.0

[1]Feet above confluence with Mississippi River
[2]Feet above State Route 55
[3]Width/width within county boundary
[4]Administrative Floodway
*Data not computed

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS CO., MN
(UNINCORPORATED AREAS)

FLOODWAY DATA

CLEARWATER RIVER - NORTH FORK CROW RIVER (MUD LAKE)

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
North Fork Crow River								
A	4,680[1]	160	790	4.6	1,147.7	1,147.7	1,147.7	0.0
B	5,510[1]	330	1,420	2.6	1,148.7	1,148.7	1,148.7	0.0
C	5,890[1]	80	680	5.3	1,149.0	1,149.0	1,149.0	0.0
D	7,220[1]	260	940	3.9	1,150.2	1,150.2	1,150.2	0.0
E	9,440[1]	430/320[2]	1,240	2.9	1,153.6	1,153.6	1,153.6	0.0
F	10,320[1]	580/420[2]	2,110	1.7	1,154.4	1,154.4	1,154.4	0.0
G	11,540[1]	260/60[2]	1,070	3.4	1,155.4	1,155.4	1,155.4	0.0
H	12,000[1]	280/100[2]	1,670	2.2	1,157.0	1,157.0	1,157.0	0.0

[1]Feet above State Route 23

[2]Width/width within county boundary

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS COUNTY, MN

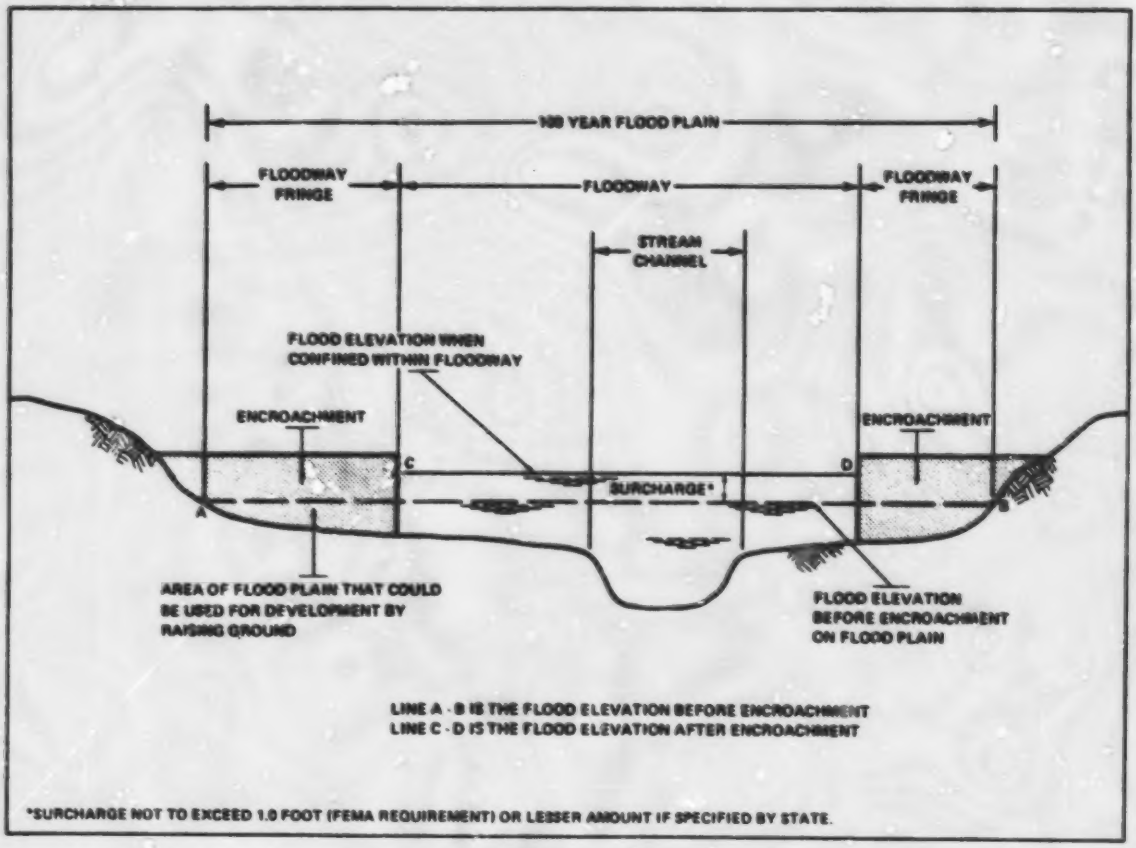
(UNINCORPORATED AREAS)

FLOODWAY DATA

NORTH FORK CROW RIVER

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 0.5 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
A
B
SURCHARGE*
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 2

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 3 for certain downstream cross sections of the Clearwater River are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.

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5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail in the unincorporated areas of Stearns County.

5.1 Reach Determinations

Reaches are defined as sections of floodplain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following tabulation for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of the unincorporated areas of Stearns County are shown on the Flood Profiles (Exhibit 1) and summarized in Table 4.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Mississippi River							
Reach 1	195,285, 305,315	-4.0	-1.3	+2.7	040	A8	Varies
Reach 2	185	-3.8	-1.1	+2.7	040	A8	Varies
Reach 3	80,85,95, 185	-4.0	-1.3	+2.8	040	A8	Varies
Watab River							
Reach 1	180,185	-2.0	-0.5	+2.1	020	A4	Varies
Sauk River							
Reach 1	185,190, 195,260, 280	-3.0	-1.0	+2.3	030	A6	Varies
Reach 2	255,260, 265,270, 355	-3.6	-1.0	+3.6	035	A7	Varies
Reach 3	255	-4.2	-1.5	+3.9	040	A8	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS CO., MN
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

MISSISSIPPI RIVER - WATAB RIVER - SAUK RIVER

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Clearwater River							
Reach 1	315,405	-1.25	-0.37	+0.88	015	A3	Varies
Reach 2	405,385	-2.01	-0.60	+1.36	020	A4	Varies
Reach 3	385,390	-1.12	-0.34	+0.97	010	A2	Varies
North Fork Crow River (Mud Lake)							
Reach 1	335	-2.05	-0.50	+1.23	020	A4	Varies
North Fork Crow River							
Reach 1	243,245, 265,330, 335	-1.68	-0.45	+0.92	015	A3	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS CO., MN
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

CLEARWATER RIVER - NORTH FORK CROW RIVER (MUD LAKE) - NORTH FORK CROW RIVER

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zones A2, A3, A4, A6, A7, and A8:	Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding; not subdivided.

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the community are shown in Table 4.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the unincorporated areas of Stearns County is, for insurance purposes, the principal result of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

In 1974, the COE prepared a Flood Plain Information report for the vicinity of St. Cloud (Reference 26). The results of this study are in agreement with the results of that report. However, flood boundaries and floodway widths may not match between studies because the mapping used in this study is more current than that used in the Flood Plain Information report. Discrepancies exist in the 100-year water-surface profiles on the Watab River at the upstream Sartell corporate limits. Differences in Manning's "n" values for the reach of the Watab River analyzed in both studies and differences in channel soundings through the City of Sartell

account for the discrepancies. Because of these differences, the 100-year water-surface profiles developed in this study at the upstream Sartell corporate limits are approximately 2.0 feet higher than those developed in COE report.

Flood Insurance Studies for the Cities of Sauk Rapids, Cold Spring, Sartell, Melrose, Rockville, and Sauk Centre; and the unincorporated areas of Morrison, Benton, and Sherburne Counties have been published (References 25, 27, 34, 35, 36, 37, 38, 39, and 40). The results of this study are in agreement with the results of those studies.

A Flood Insurance Study for the City of Clearwater has also been published (Reference 28). The results of this study are not in agreement with the results of that study. Hydrologic data for the Clearwater River in this study were based on a more current HEC-1 model. This data was used in conjunction with information from the Clearwater study to develop new starting elevations for the Clearwater River hydraulic analysis in this study.

A Flood Insurance Study for the unincorporated areas of Wright County is currently being prepared (Reference 41). The results of that study will be in agreement with the results of this study.

Due to its more up-to-date analyses, this study supersedes the previous Flood Insurance Study for the unincorporated areas of Stearns County (Reference 2).

USGS Flood-Prone Area Maps were reviewed and found to be consistent with the flood boundaries produced in this study (Reference 32).

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Federal Emergency Management Agency, Natural and Technological Hazards Division, 175 West Jackson Boulevard, Fourth Floor, Chicago, Illinois 60604.

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39. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Unincorporated Areas of Benton County, Minnesota, Washington, D. C., December 4, 1981.

40. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Unincorporated Areas of Sherburne County, Minnesota, Washington, D. C., May 19, 1981.

41. Federal Emergency Management Agency, Flood Insurance Study, Unincorporated Areas of Wright County, Minnesota (Unpublished).

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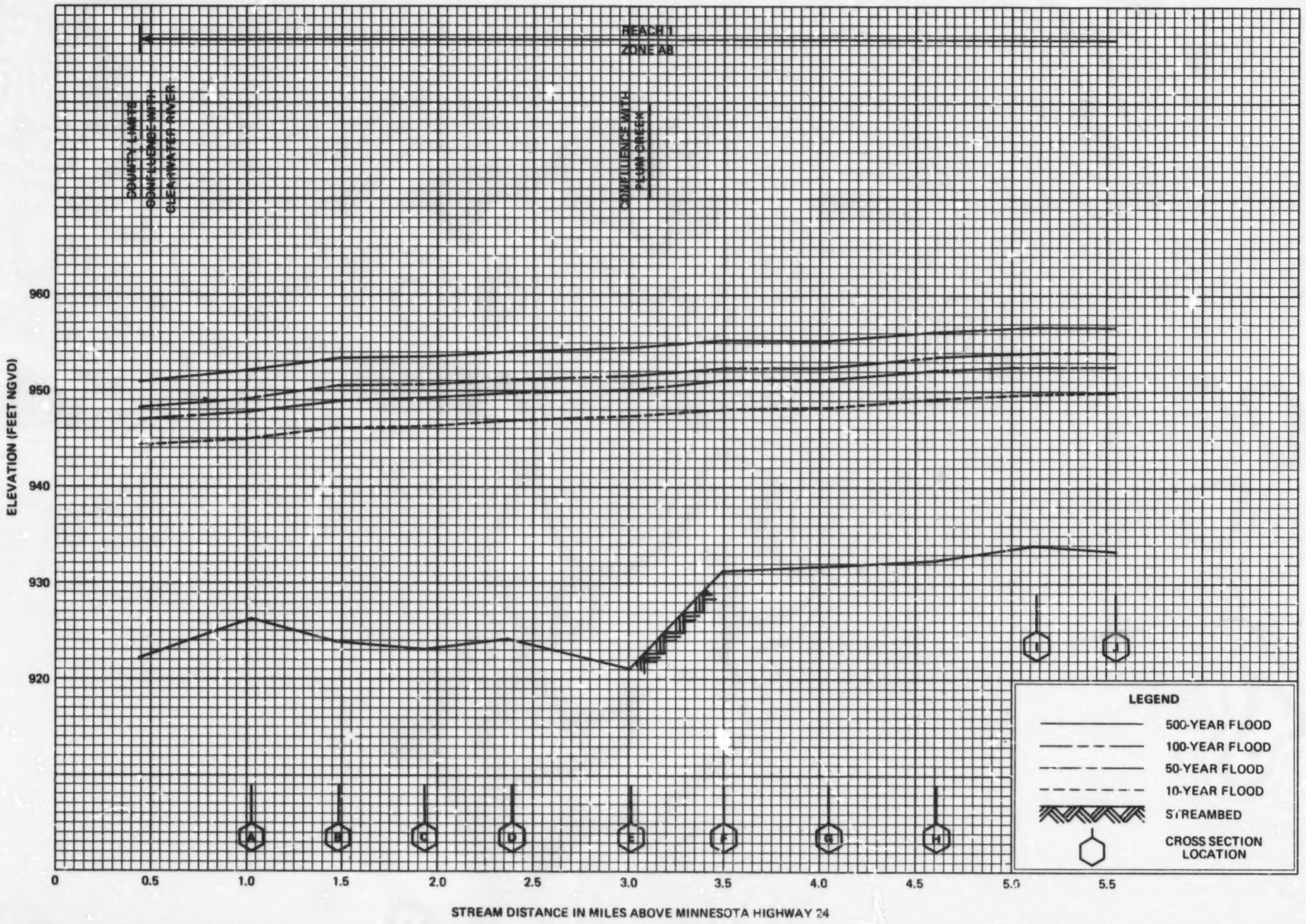

FLOOD PROFILES

MISSISSIPPI RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

01P

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REACH 1
ZONE AB

CONFLUENCE WITH JOHNSON CREEK

ELEVATION (FEET NGVD)

980
970
960
950
940
930

5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0 10.5

STREAM DISTANCE IN MILES ABOVE MINNESOTA HIGHWAY 24

J K L M N O P Q R S T U

LEGEND

- 500-YEAR FLOOD
- 100-YEAR FLOOD
- 50-YEAR FLOOD
- 10-YEAR FLOOD
- STREAMBED
- CROSS SECTION LOCATION

FLOOD PROFILES

MISSISSIPPI RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

02P

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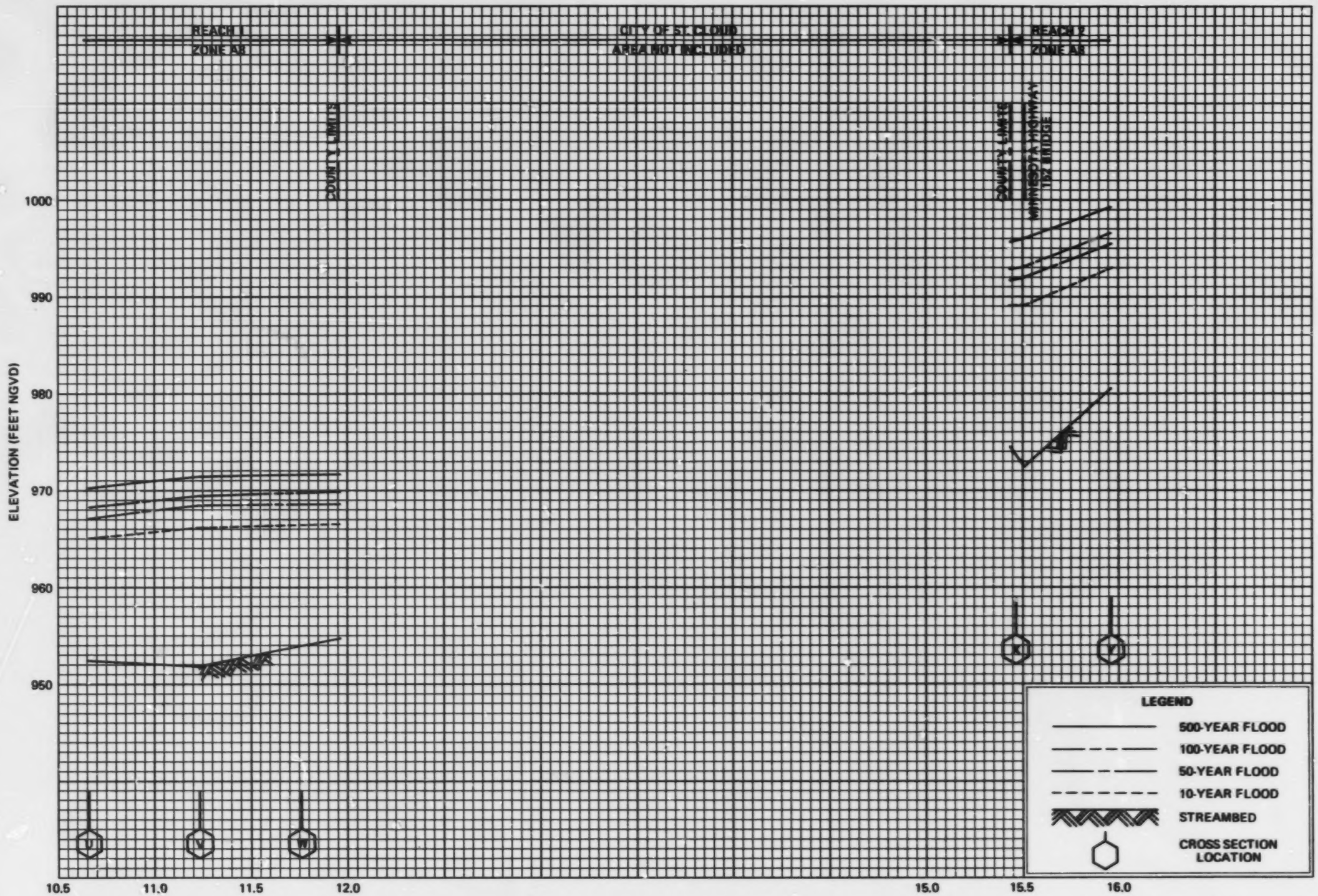

FLOOD PROFILES

MISSISSIPPI RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

03P

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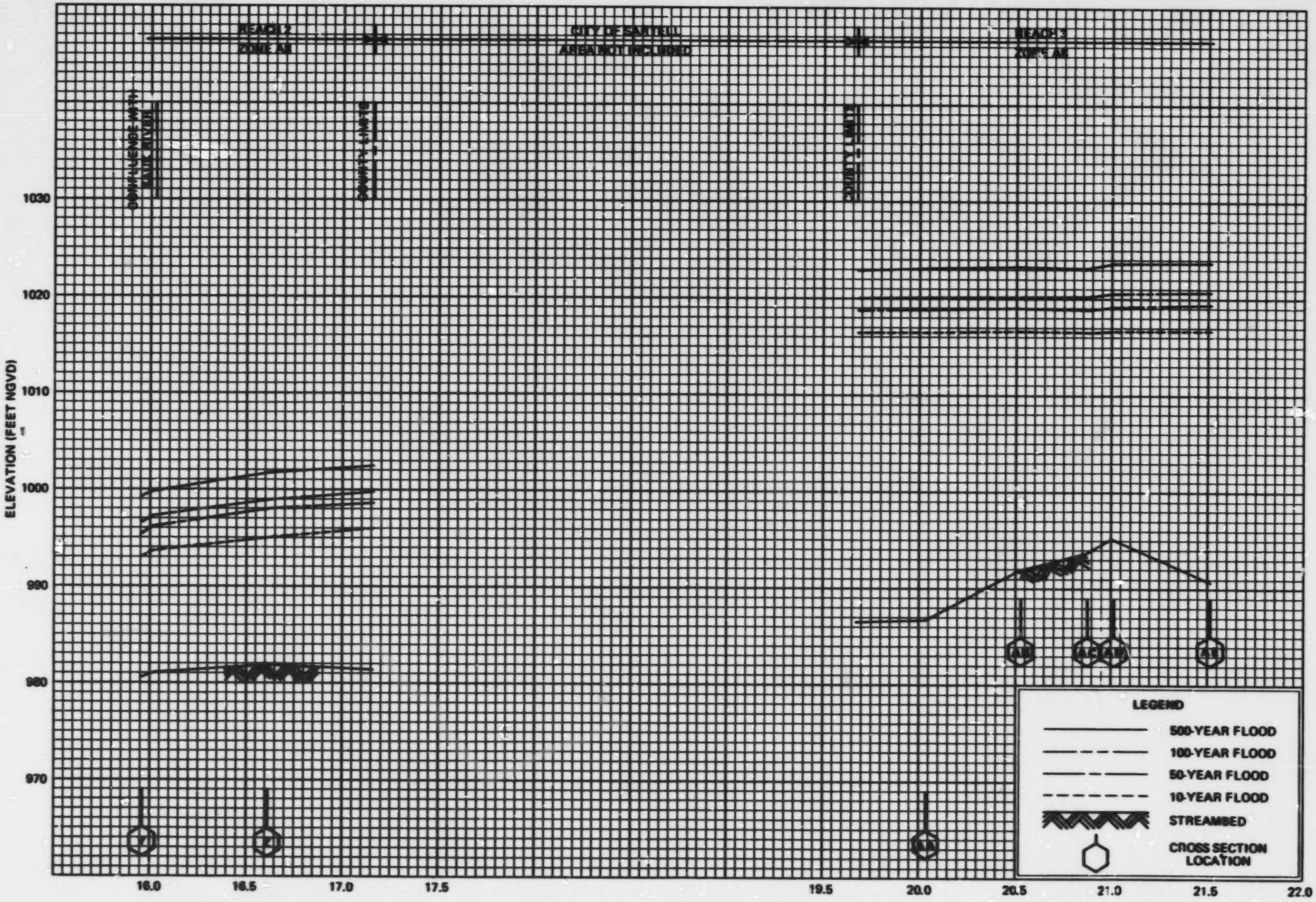

FLOOD PROFILES

MISSISSIPPI RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

04P

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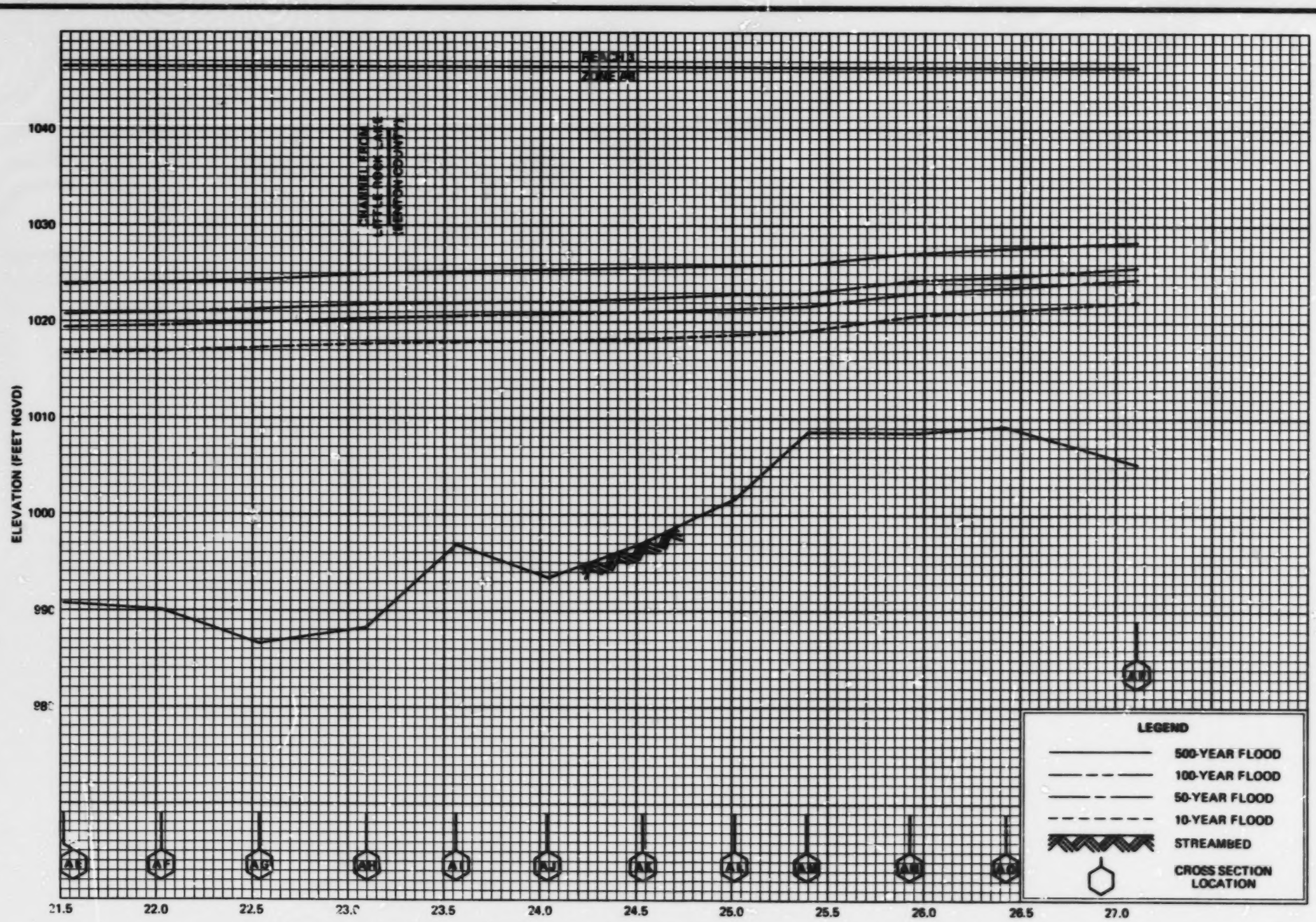

FLOOD PROFILES

MISSISSIPPI RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

05P

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REACH 3
ZONE AE

CONFLUENCE WITH STONY CREEK

COUNTY STATE AID HIGHWAY 3 BRIDGE

DOWNSTREAM LIMITS

ELEVATION (FEET NGVD)

1040
1030
1020
1010
1000
990

AH AG AN AS AR AU AV AW AA AW AZ BA BB

27.0 27.5 28.0 28.5 29.0 29.5 30.0 30.5 31.0 31.5 32.0 32.5 33.0 33.5

STREAM DISTANCE IN MILES ABOVE MINNESOTA HIGHWAY 24

LEGEND

- 500-YEAR FLOOD
- 100-YEAR FLOOD
- 50-YEAR FLOOD
- 10-YEAR FLOOD
- STREAMBED
- CROSS SECTION LOCATION

FLOOD PROFILES

MISSISSIPPI RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

06P

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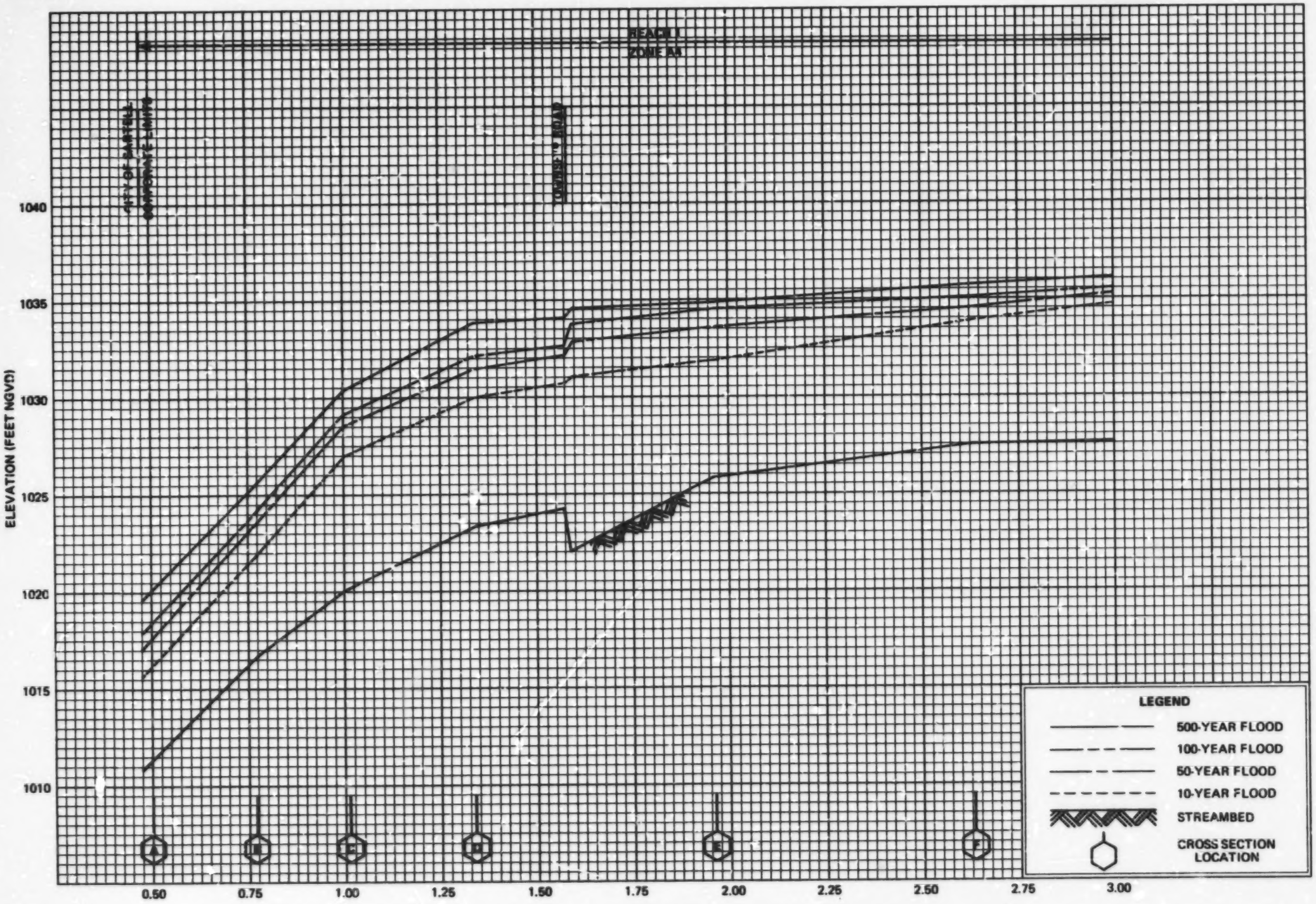

FLOOD PROFILES

WATAB RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

07P

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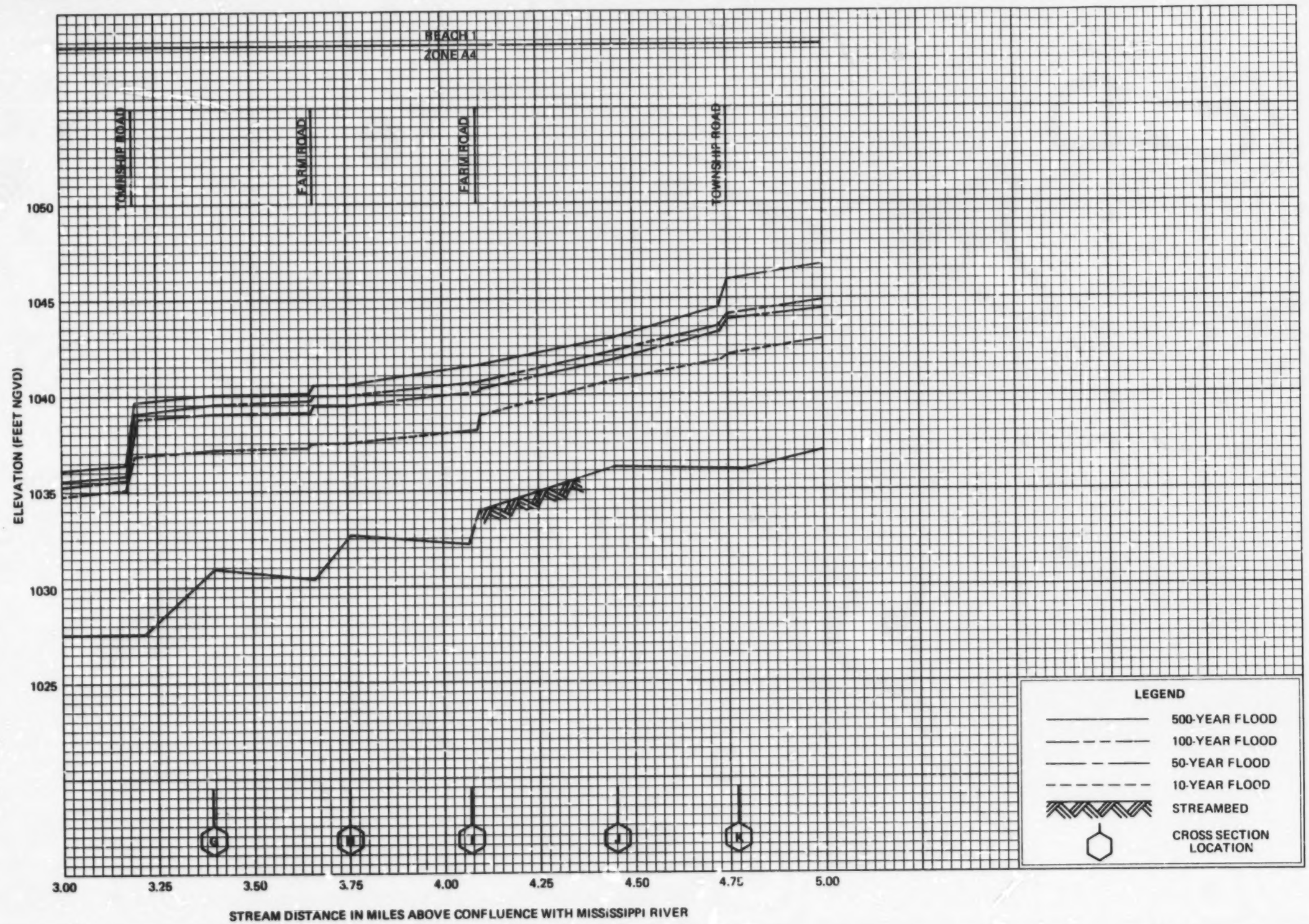

FLOOD PROFILES

WATAB RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

08P

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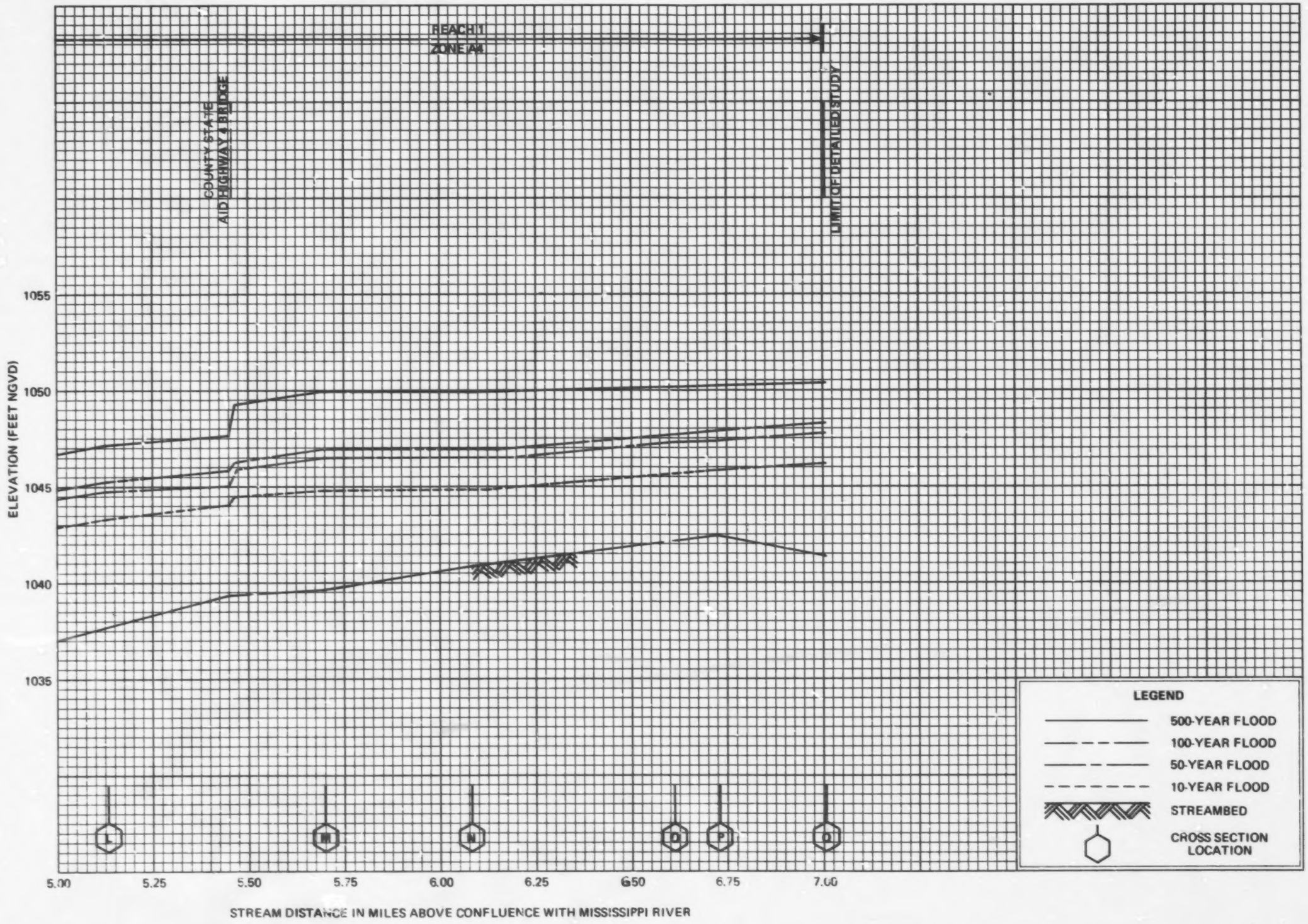

FLOOD PROFILES

WATAB RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

09P

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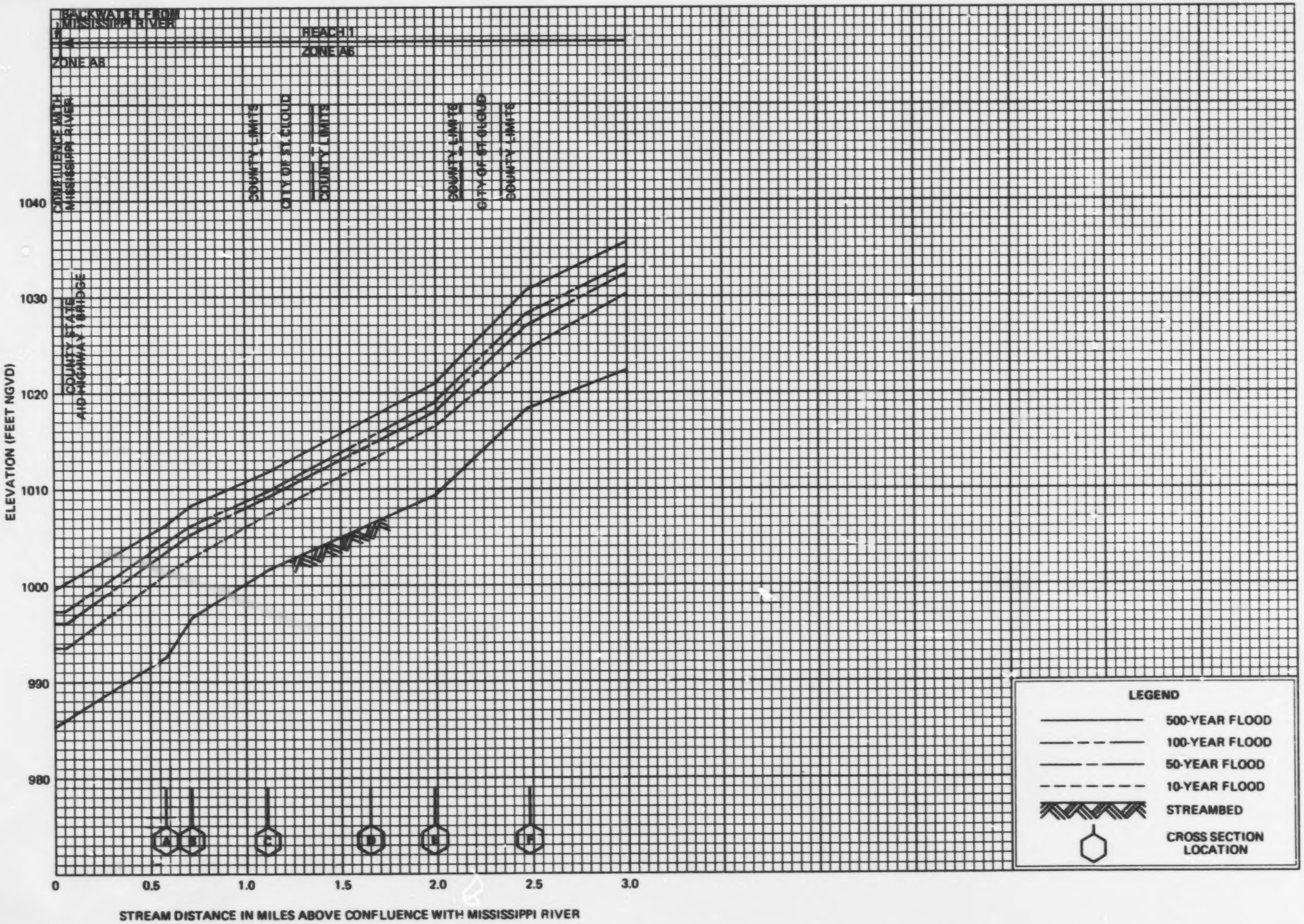

FLOOD PROFILES

SAUK RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

10P

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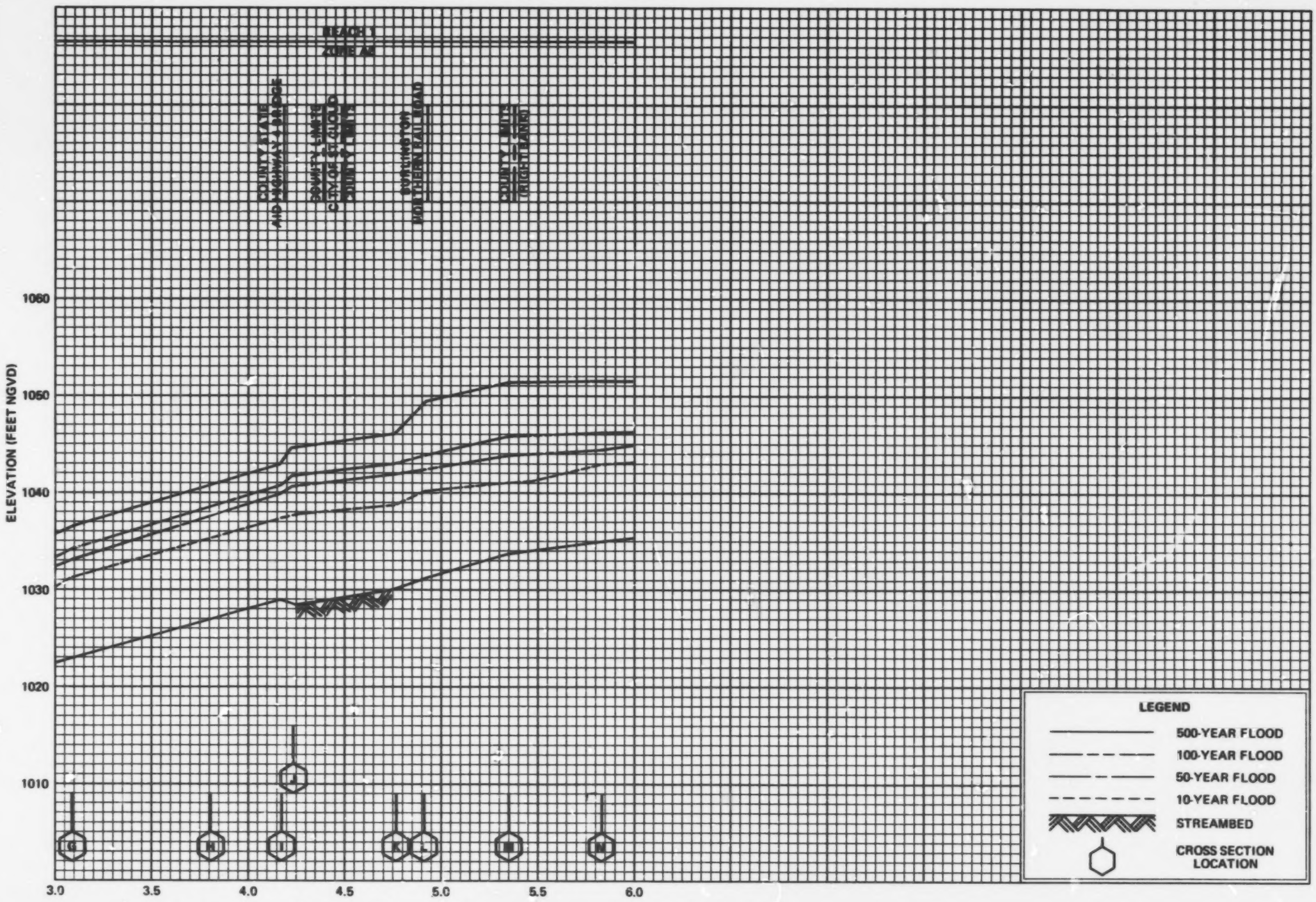

FLOOD PROFILES

SAUK RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

11P

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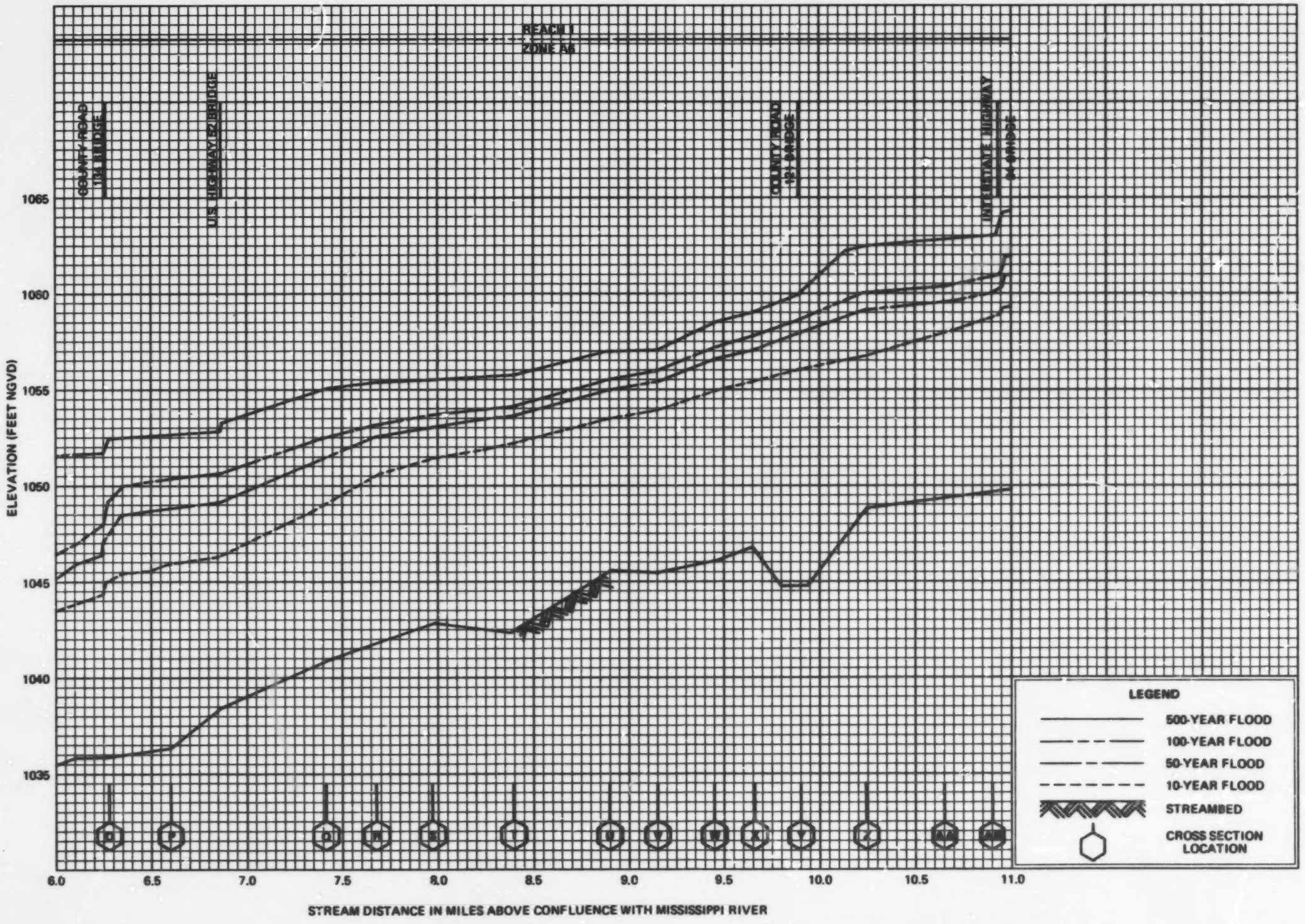

FLOOD PROFILES

SAUK RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

12P

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REACH I
ZONE AE

COUNTY LIMITS (RIGHT BANK)

COUNTY ROAD 136 BRIDGE

COUNTY LIMITS (RIGHT BANK)

ELEVATION (FEET NGVD)

1075
1070
1065
1060
1055
1050
1045

AC AD AE AF AG AH AI AJ AK AL AM AN AO AP AQ AR AS AT

LEGEND
- 500-YEAR FLOOD
- 100-YEAR FLOOD
- 50-YEAR FLOOD
- 10-YEAR FLOOD
- STREAMBED
- CROSS SECTION LOCATION

11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5

STREAM DISTANCE IN MILES ABOVE CONFLUENCE WITH MISSISSIPPI RIVER

FLOOD PROFILES

SAUK RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

13P

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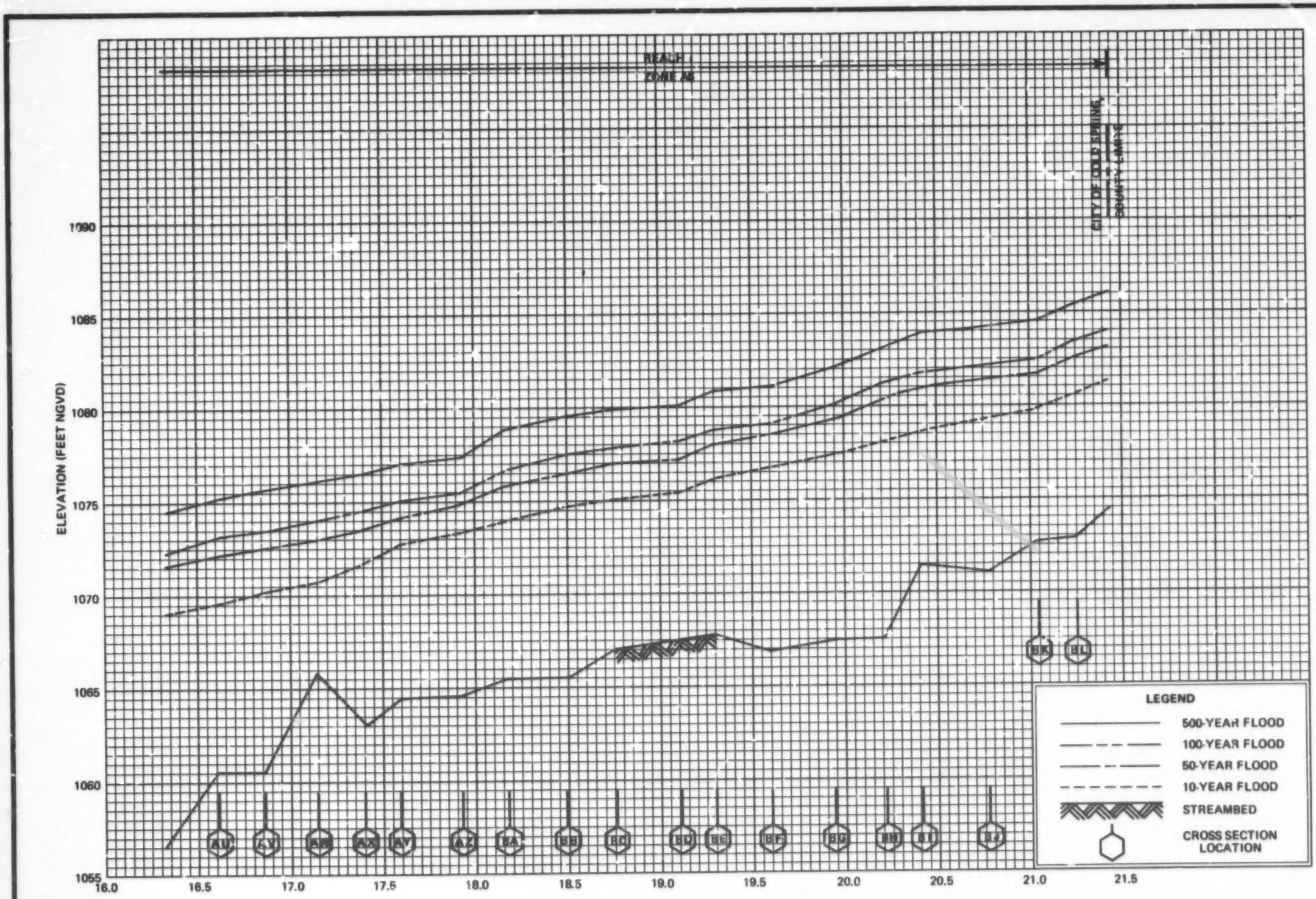

FLOOD PROFILES

SAUK RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

14P

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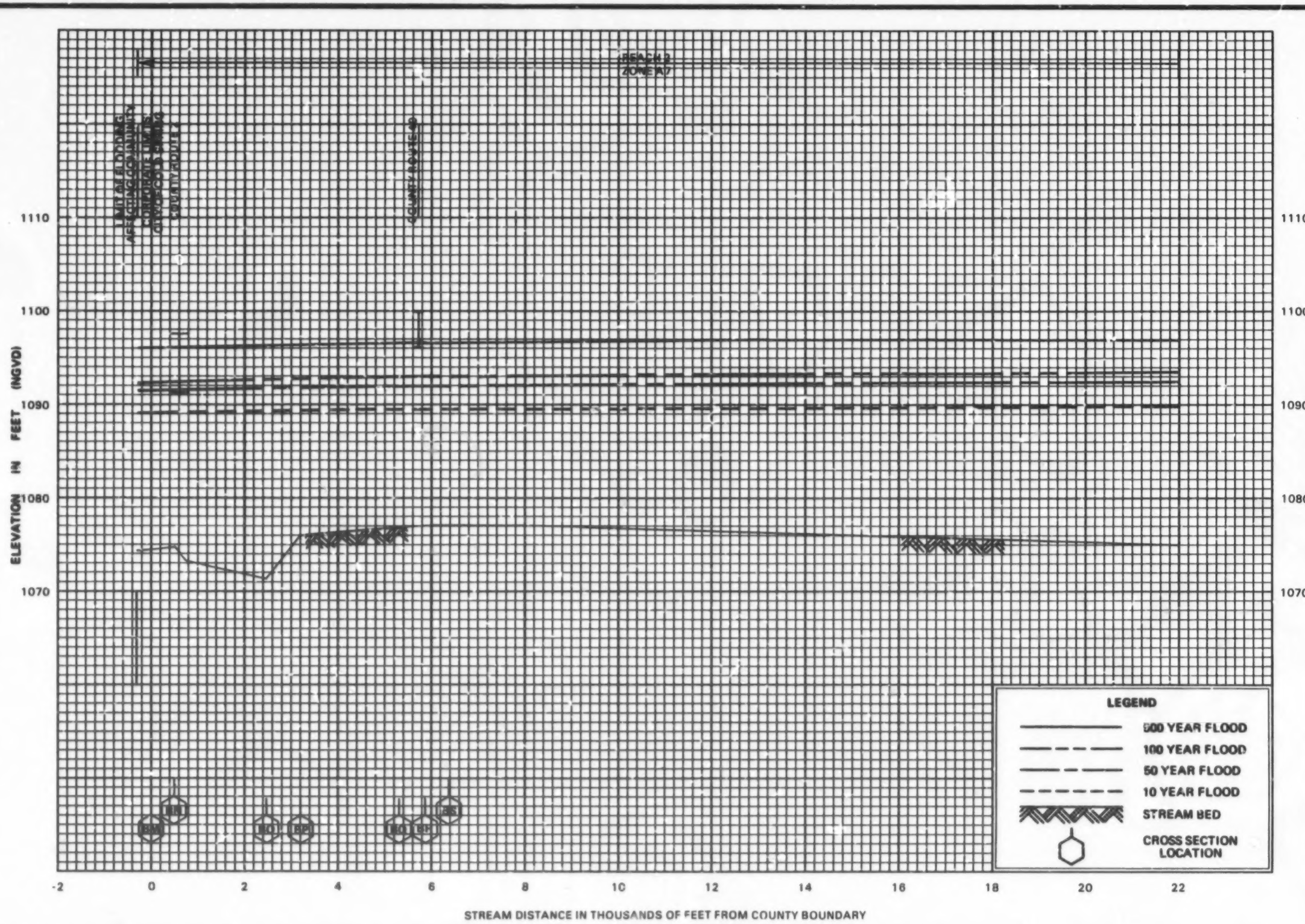


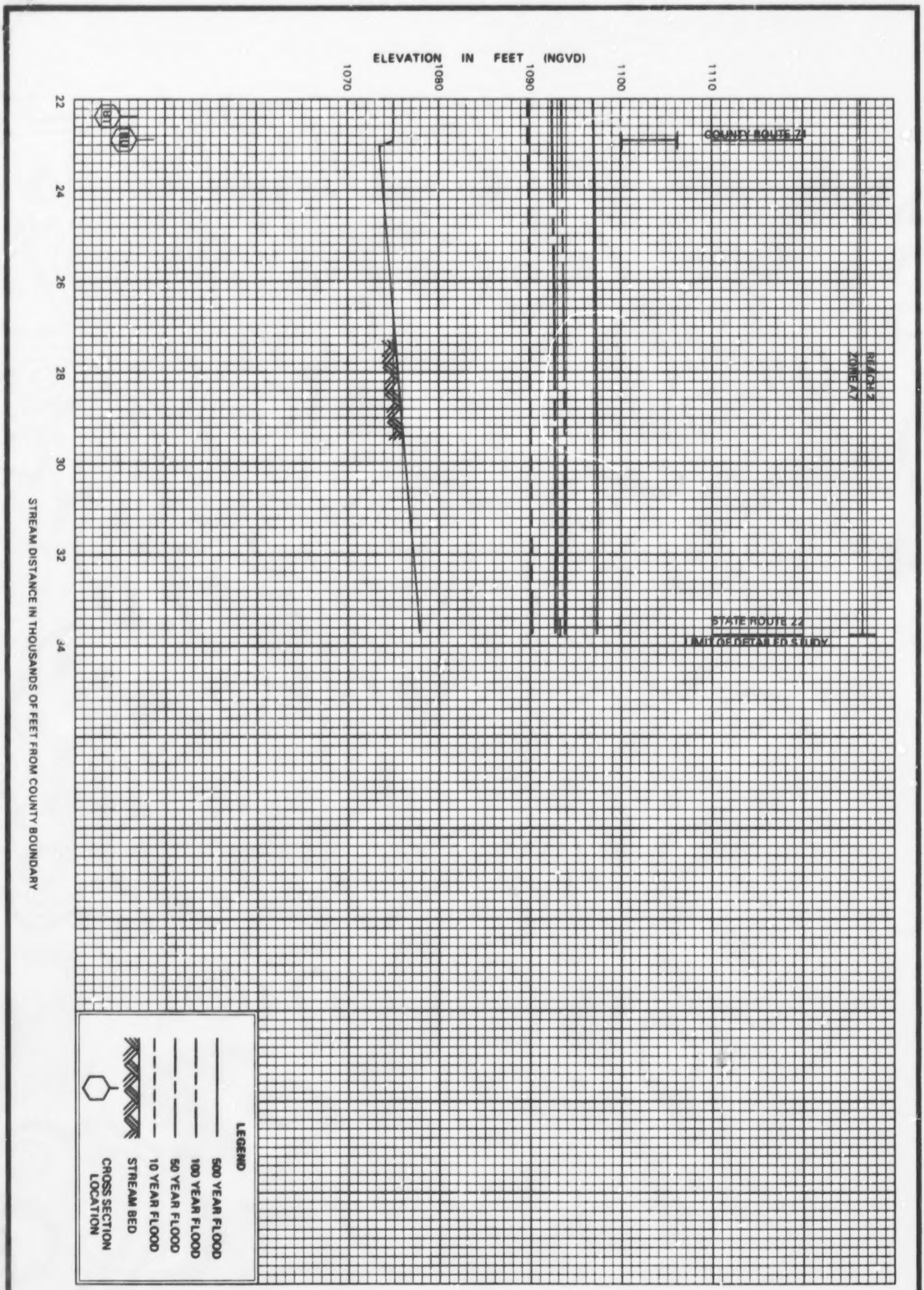
FLOOD PROFILES

SAUK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

15P



FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

FLOOD PROFILES

SAUK RIVER

16P

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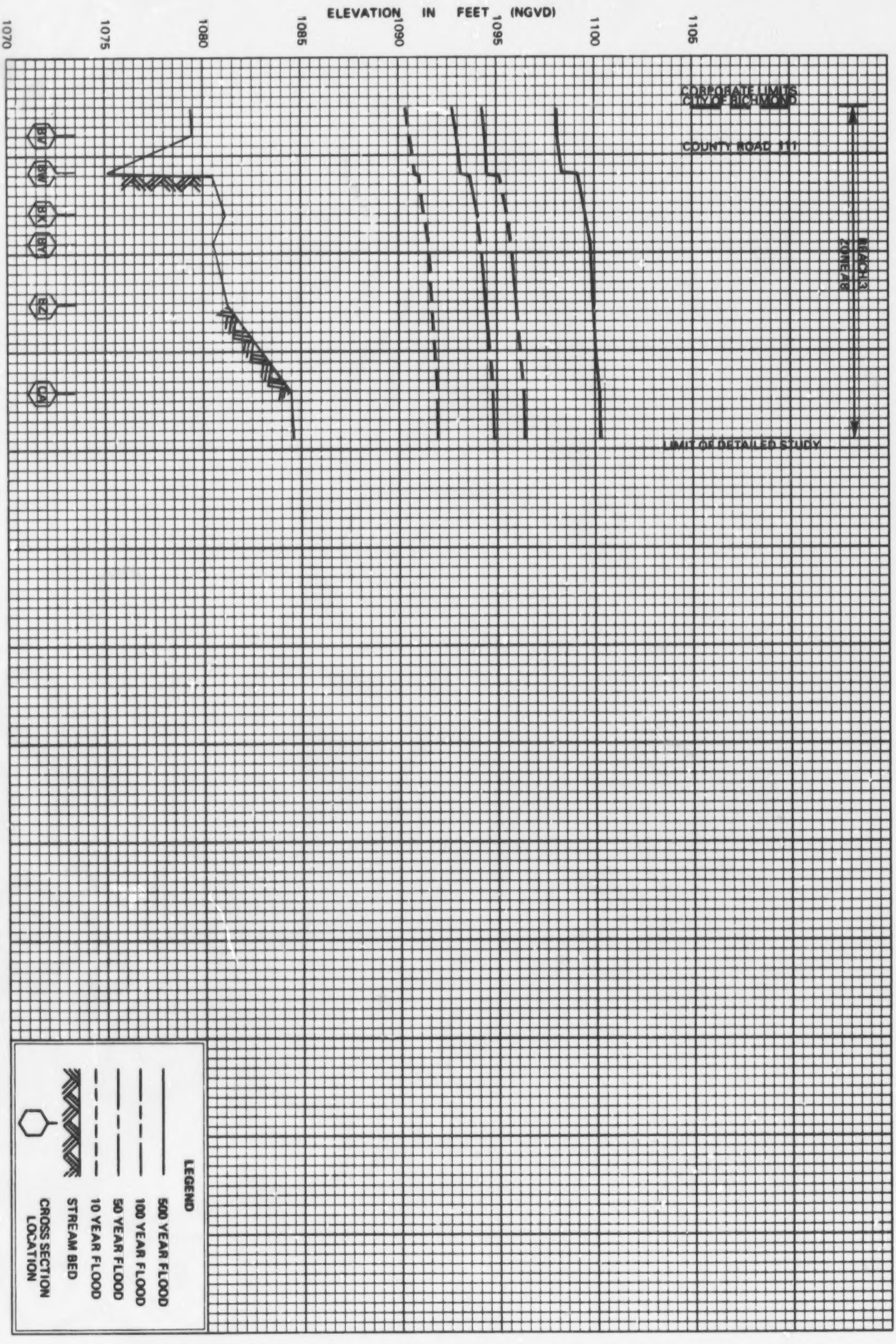

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17P	FEDERAL EMERGENCY MANAGEMENT AGENCY STEARNS COUNTY, MN (UNINCORPORATED AREAS)	FLOOD PROFILES SAUK RIVER

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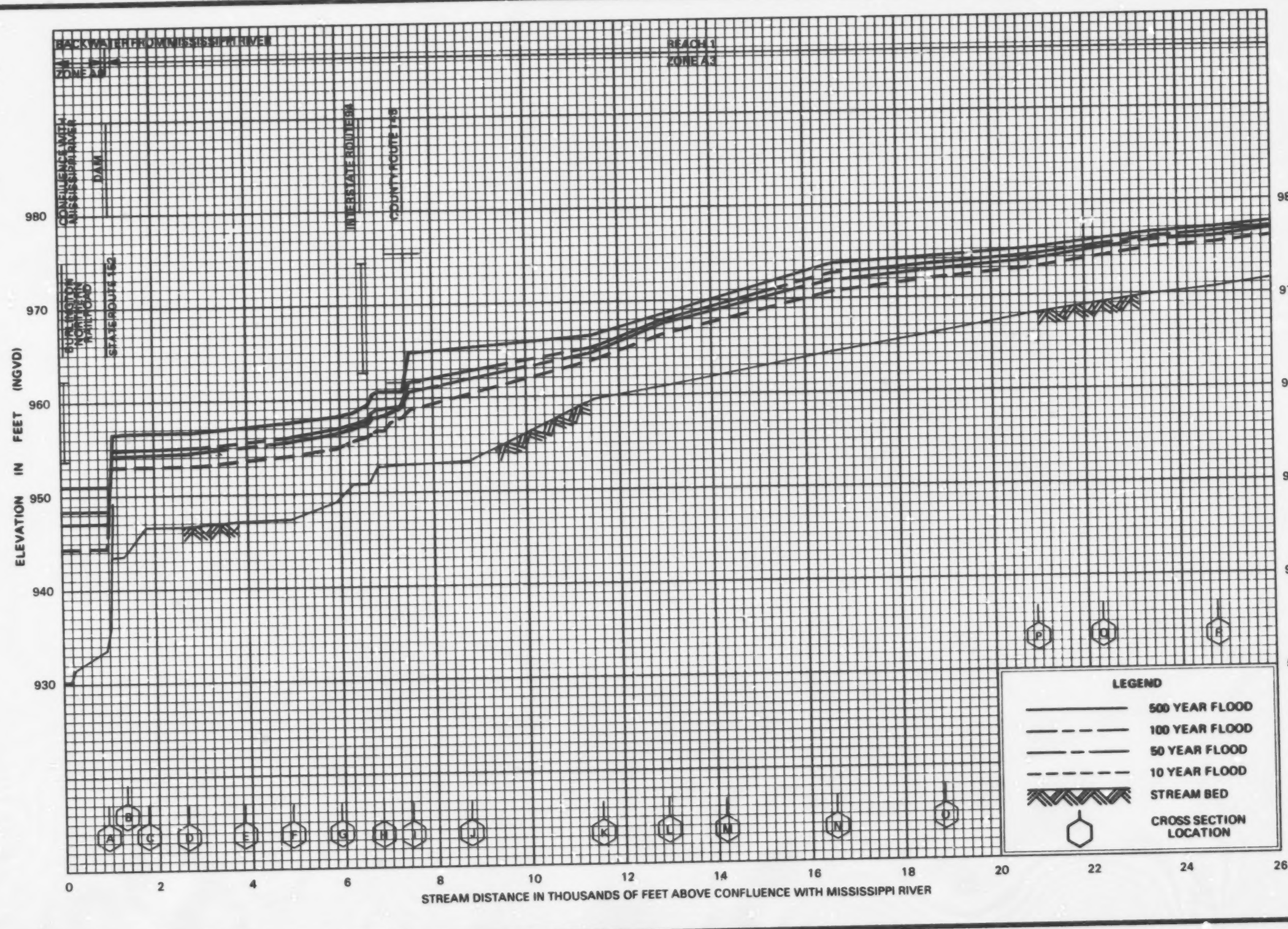

FLOOD PROFILES

CLEARWATER RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

18P

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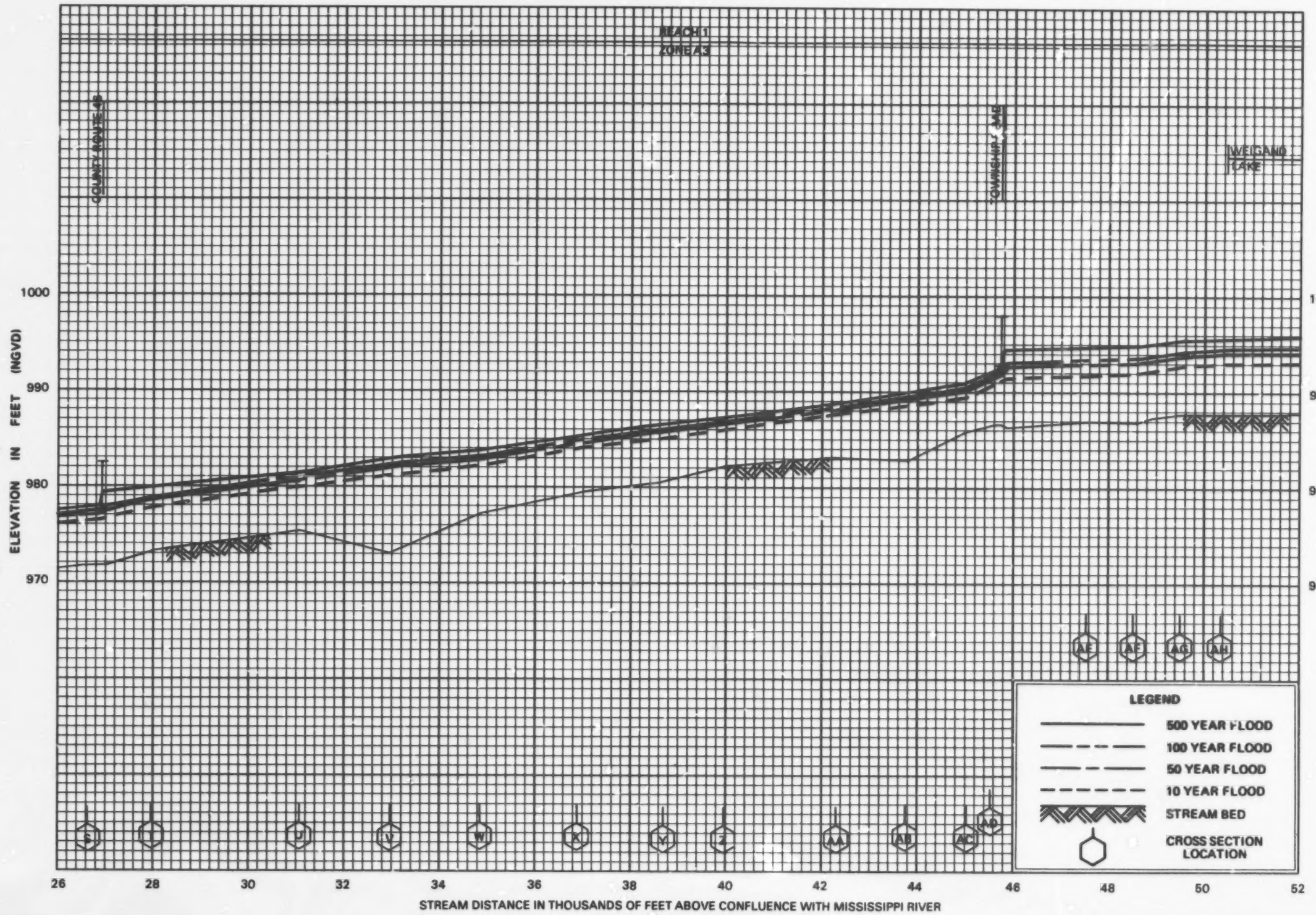

FLOOD PROFILES

CLEARWATER RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS COUNTY, MN

(UNINCORPORATED AREAS)

19P

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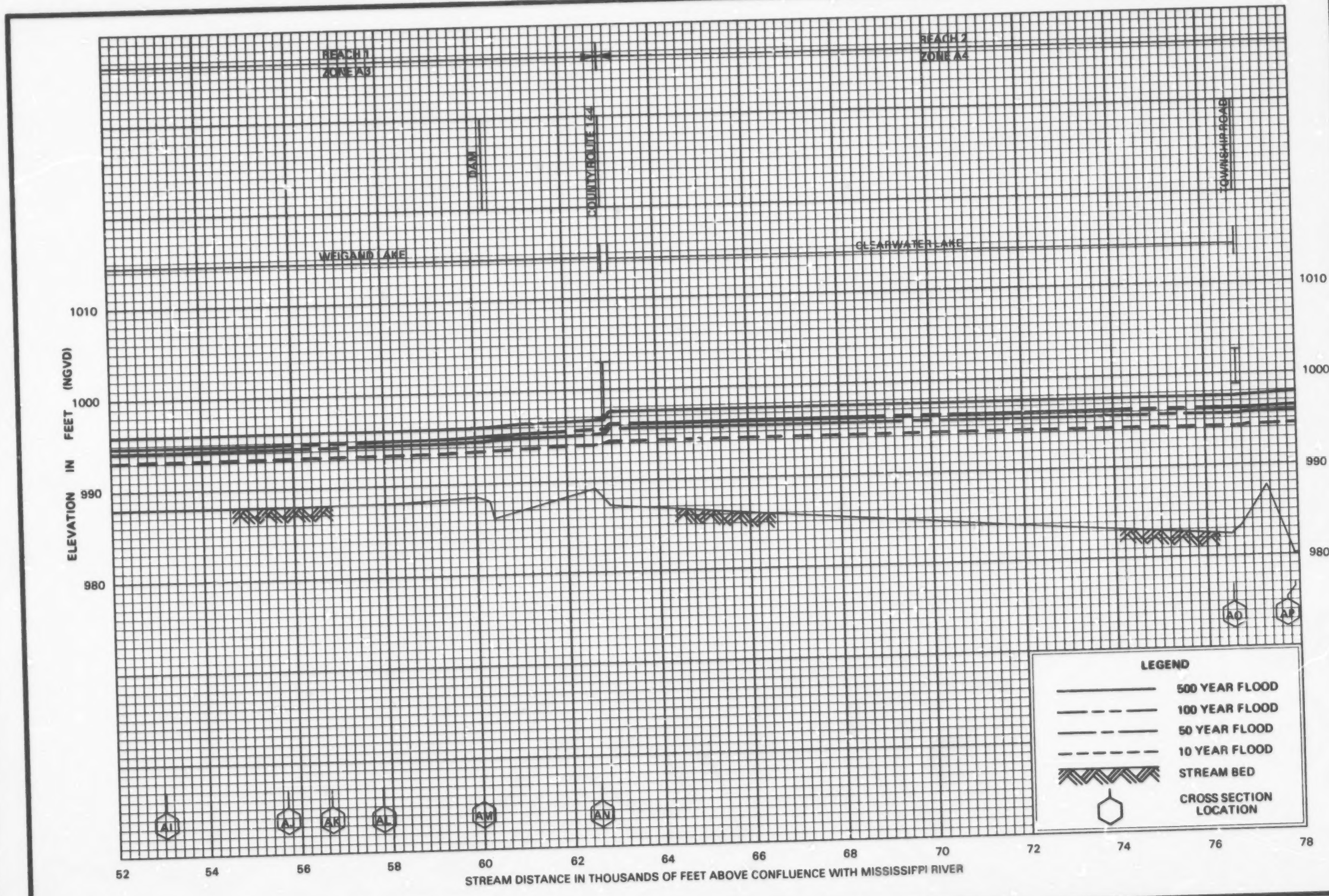

FLOOD PROFILES

CLEARWATER RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

20P

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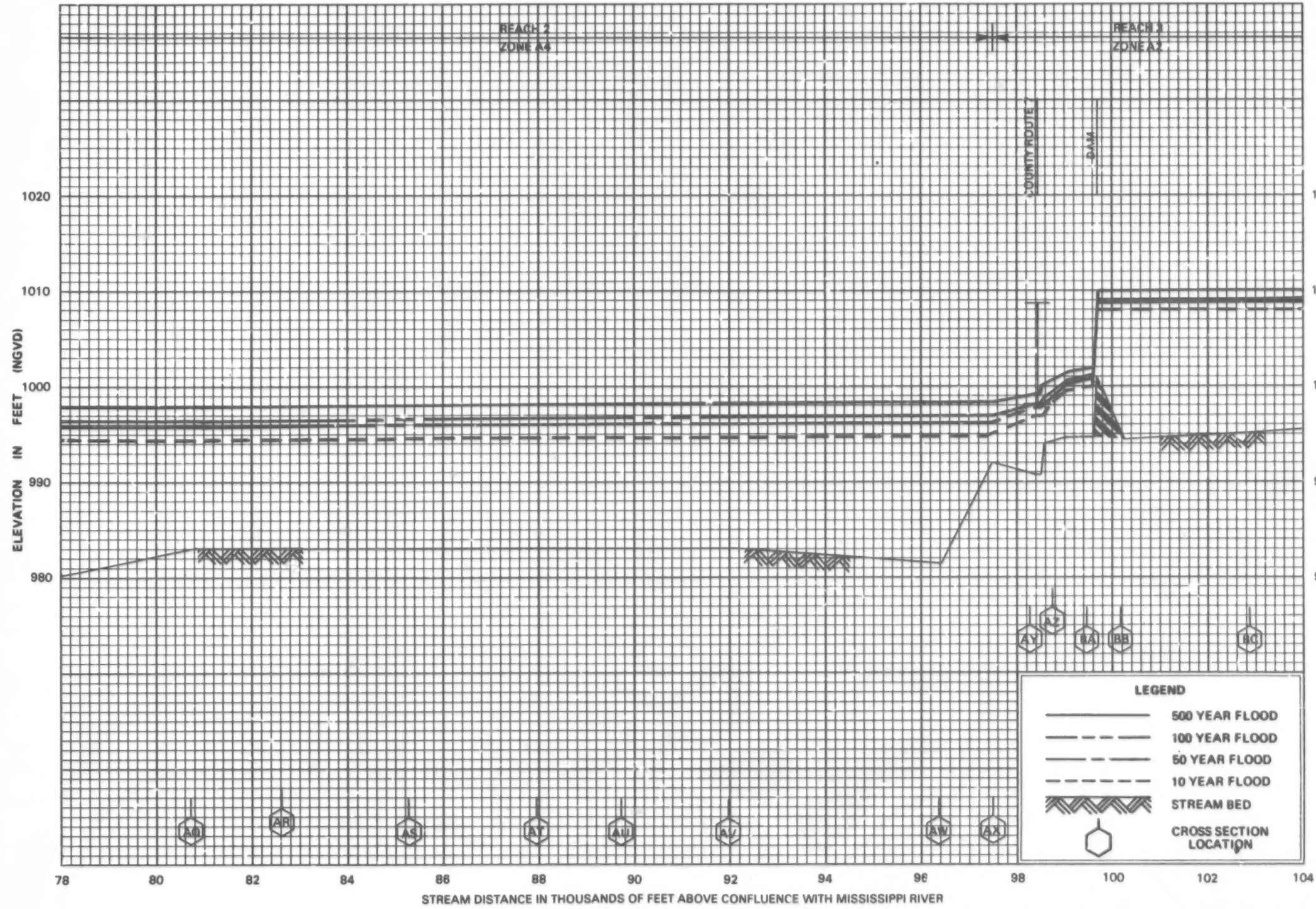

FLOOD PROFILES

CLEARWATER RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS COUNTY, MN

(UNINCORPORATED AREAS)

21P

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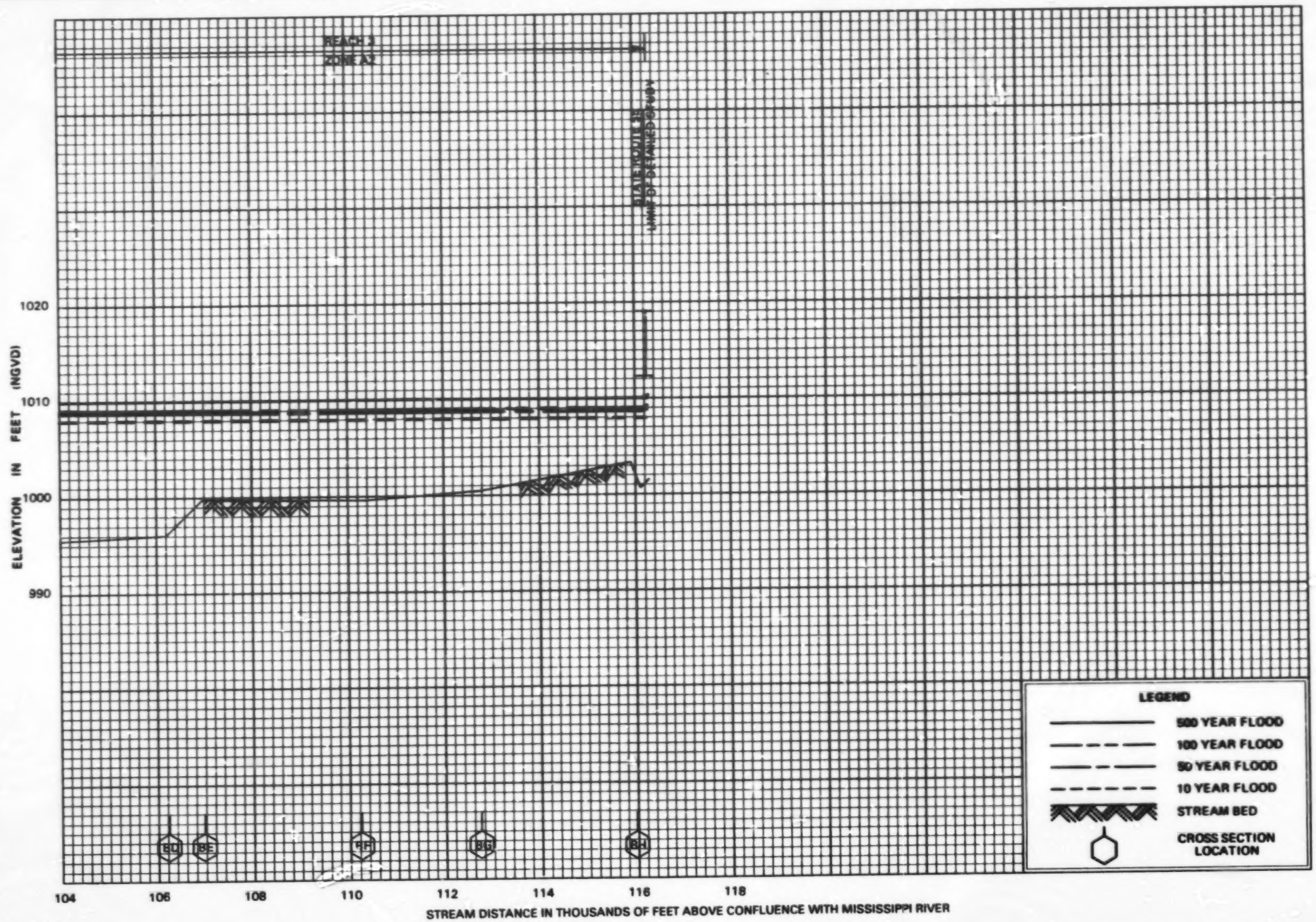

FLOOD PROFILES

CLEARWATER RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS COUNTY, MN

UNINCORPORATED AREAS)

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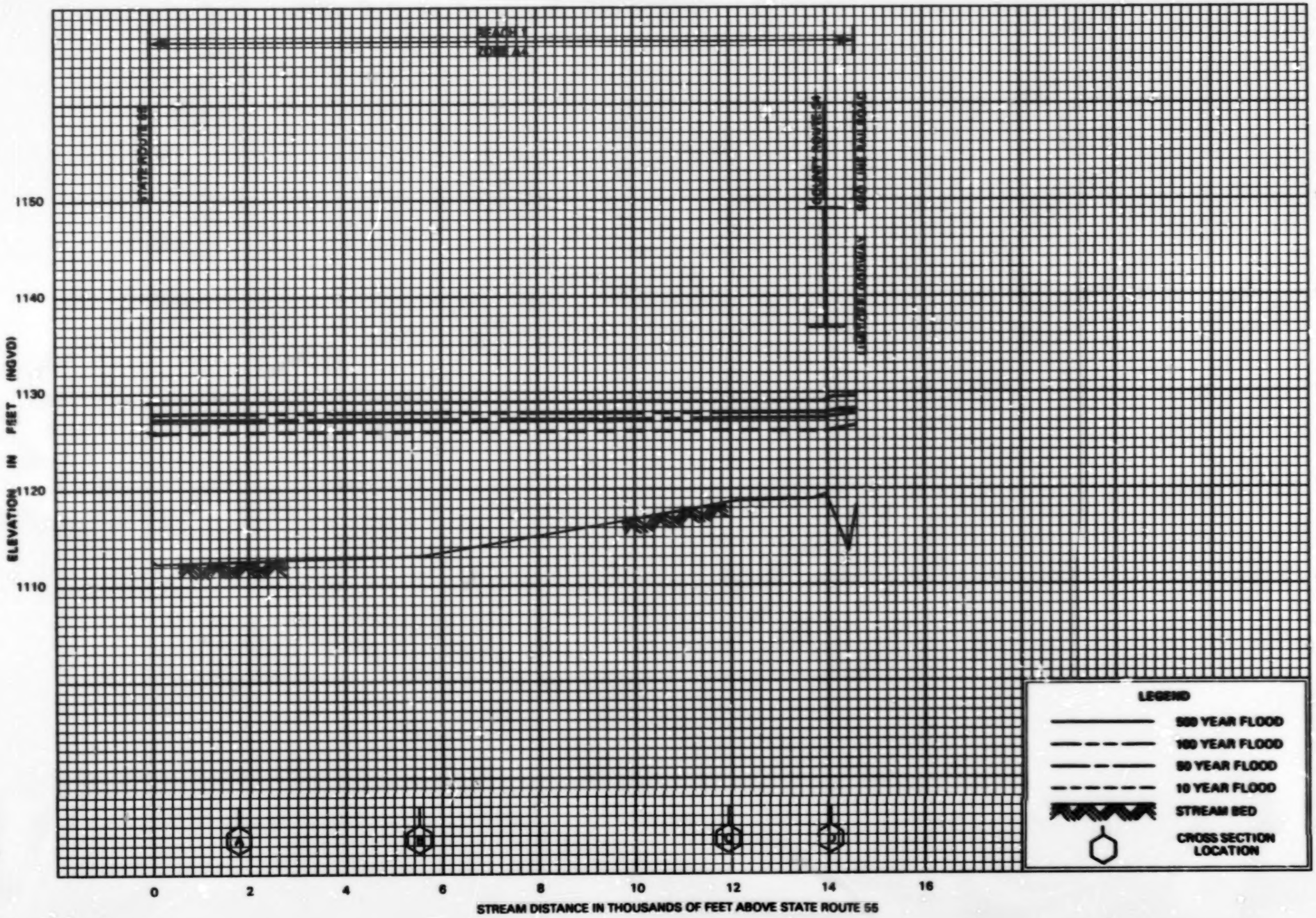

FLOOD PROFILES

NORTH FORK CROW RIVER (MUD LAKE)

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

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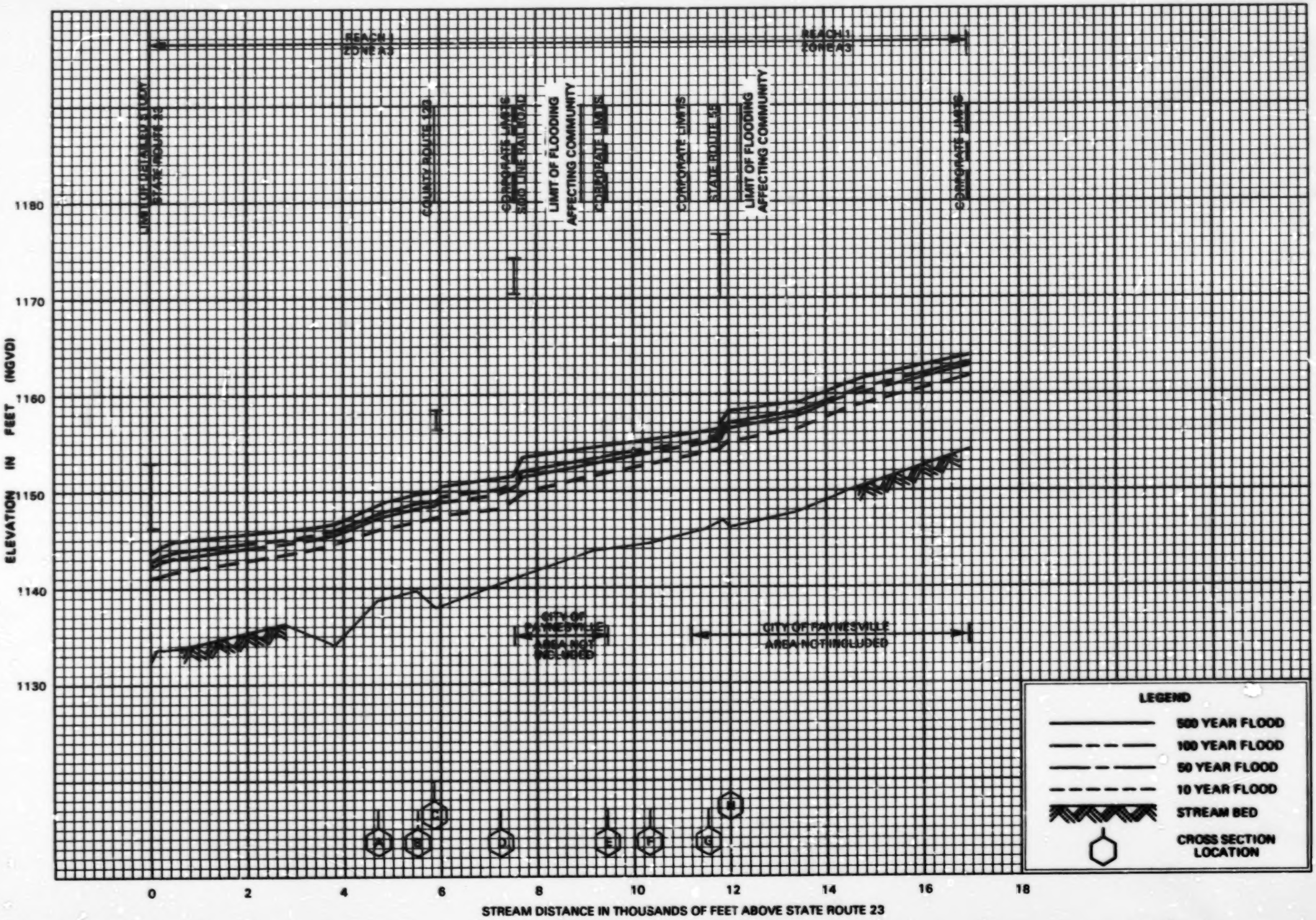

FLOOD PROFILES

NORTH FORK CROW RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

STEARNS COUNTY, MN
(UNINCORPORATED AREAS)

24P